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DOE/MA-0064/4
Volume 2 of 7

Congressional Budget Request

Energy Supply Research and Development
Nuclear Waste fund

Volume 2

FY 1987

U.S. Department of Energy
Assistant Secretary,
Management and Administration
Office of the Controller

February 1986

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Volume 2 of 7

Congressional Budget Request

Energy Supply Research and Development
Nuclear Waste fund

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U.S. Department of Energy
Assistant Secretary,
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Washington, D.C. 20585

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DEPARTMENT OF ENERGY

FISCAL YEAR 1987 CONGRESSIONAL BUDGET REQUEST

ENERGY SUPPLY RESEARCH AND DEVELOPMENT

NUCLEAR WASTE FUND

VOLUME 2

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DEPARTMENT OF ENERGY

FISCAL YEAR 1987 CONGRESSIONAL BUDGET REQUEST

SUMMARY OF ESTIMATES BY APPROPRIATIONS

(in thousands of dollars)

	FY 1985 Actual BA	FY 1986 Estimate BA	FY 1987 Request BA
Appropriations Before The Energy and Water Development Subcommittees:			
Energy Supply Research and Development	1,967,490	1,696,298	1,254,162
Uranium Enrichment	237,956	190,512	---
General Science and Research	724,860	655,928	773,400
Atomic Energy Defense Activities ..	7,322,321	7,231,664	8,230,000
Departmental Administration	128,602	150,319	151,082
Alaska Power Administration	3,233	3,245	2,881
Bonneville Power Administration ...	284,771	330,000	276,100
Southeastern Power Administration .	35,744	---	19,647
Southwestern Power Administration .	31,208	29,191	25,337
Western Area Power Administration .	218,230	195,910	240,309
Western Area Power Emergency Fund .	---	---	---
Federal Energy Regulatory Commission	54,543	41,989	20,325
Nuclear Waste Fund	327,669	499,037	769,349
Geothermal Resources Development Fund	121	69	72
Subtotal, Appropriations Before the Energy and Water Development Subcommittees	$11,336,748	$11,024,162	$11,762,664

DEPARTMENT OF ENERGY

FISCAL YEAR 1987 CONGRESSIONAL BUDGET REQUEST

SUMMARY OF ESTIMATES BY APPROPRIATIONS

(in thousands of dollars)

	FY 1985 Actual BA	FY 1986 Estimate BA	FY 1987 Request BA
Appropriations Before Interior and Related Agencies Subcommittees:			
Alternative Fuels Production	$ 1,169,895	$ ---	$ ---
Clean Coal Technology	---	---	---
Fossil Energy Research and Development	289,048	311,954	82,767
Naval Petroleum and Oil Shale Reserves	156,874	13,002	127,108
Energy Conservation	457,436	427,512	39,433
Energy Regulation	27,139	23,423	21,850
Emergency Preparedness	6,045	5,750	6,044
Strategic Petroleum Reserve	2,049,550	107,533	---
Energy Information Activities	60,919	57,724	59,651
Subtotal, Interior and Related Agencies Subcommittees	4,216,906	946,898	336,853
Subtotal, Energy and Water Development Subcommittees	11,336,748	11,024,162	11,762,664
Subtotal, Department of Energy	15,553,654	11,971,060	12,099,517
Permanent - Indefinite Appropriations:			
Payments to States	1,052	570	570
Total, Department of Energy	$15,554,706	$11,971,630	$12,100,087

DEPARTMENT OF ENERGY
FY 1987 CONGRESSIONAL STAFFING REQUEST
TOTAL WORK FORCE

	FY1985 FTE USAGE	FY1986 CONGR REQ	FY1987 -FY86	FY1987 CONGR REQ
ENERGY & WATER SUBCOMMITTEE				
HEADQUARTERS	4,865	4,965	-18	4,947
FIELD	9,133	9,185	111	9,296
SUBCOMMITTEE TOTAL	13,998	14,150	93	14,243
INTERIOR SUBCOMMITTEE				
HEADQUARTERS	1,353	1,304	-166	1,138
FIELD	907	896	-226	670
SUBCOMMITTEE TOTAL	2,260	2,200	-392	1,808
GRAND TOTAL	16,258	16,350	-299	16,051
ADJUSTMENT		-132	-198	-330
ADJUSTED TOTAL	16,258	16,218	-497	15,721

DEPARTMENT OF ENERGY
FY 1987 CONGRESSIONAL STAFFING REQUEST
TOTAL WORK FORCE

	FY1985 FTE USAGE	FY1986 CONGR REQ	FY1987 -FY86	FY1987 CONGR REQ
10:ENERGY SUPPLY RESEARCH AND DEV	937	934	-34	900
HEADQUARTERS	811	820	-28	792
FIELD	126	114	-6	108
15:URANIUM ENRICHMENT	69	66	1	67
HEADQUARTERS	58	55	1	56
FIELD	11	11	0	11
20:GENERAL SCIENCE AND RESEARCH	37	39	0	39
HEADQUARTERS	37	39	0	39
25:ATOMIC ENERGY DEFENSE ACTIVITI	2,618	2,702	131	2,833
HEADQUARTERS	496	518	9	527
FIELD	2,122	2,184	122	2,306
30:DEPARTMENTAL ADMINISTRATION	3,307	3,332	-5	3,327
HEADQUARTERS	1,721	1,726	0	1,726
FIELD	1,586	1,606	-5	1,601
34:ALASKA POWER ADMINISTRATION	37	38	0	38
FIELD	37	38	0	38
36:BONNEVILLE POWER ADMIN	3,510	3,480	0	3,480
FIELD	3,510	3,480	0	3,480
38:SOUTHEASTERN POWER ADMIN	38	40	0	40
FIELD	38	40	0	40
42:SOUTHWESTERN POWER ADMIN	186	186	0	186
FIELD	186	186	0	186
46:WESTERN AREA POWER ADMIN	1,181	1,160	0	1,160
FIELD	1,181	1,160	0	1,160
50:WAPA - COLORADO RIVER BASIN	219	219	0	219
FIELD	219	219	0	219
52:FEDERAL ENERGY REGULATORY COMM	1,617	1,659	0	1,659
HEADQUARTERS	1,617	1,659	0	1,659
54:NUCLEAR WASTE FUND	238	292	0	292
HEADQUARTERS	123	147	0	147
FIELD	115	145	0	145
56:GEOTHERMAL RESOURCES DEV FUND	2	1	0	1
HEADQUARTERS	2	1	0	1
65:FOSSIL ENERGY RESEARCH AND DEV	714	700	-161	539
HEADQUARTERS	151	135	-26	109
FIELD	563	565	-135	430
70:NAVAL PETROL & OIL SHALE RES	104	104	-9	95
HEADQUARTERS	23	23	0	23
FIELD	81	81	-9	72
75:ENERGY CONSERVATION	333	352	-134	218
HEADQUARTERS	208	227	-79	148
FIELD	125	125	-55	70
80:EMERGENCY PREPAREDNESS	74	71	0	71
HEADQUARTERS	74	71	0	71
81:ECONOMIC REGULATION	377	340	-50	290
HEADQUARTERS	377	340	-50	290
85:STRATEGIC PETROLEUM RESERVE	178	152	-32	120
HEADQUARTERS	40	27	-5	22
FIELD	138	125	-27	98
90:ENERGY INFORMATION ACTIVITIES	480	481	-6	475
HEADQUARTERS	480	481	-6	475
94:ADVANCES FOR CO-OP WORK	2	2	0	2
FIELD	2	2	0	2
GRAND TOTAL	16,258	16,350	-299	16,051
ADJUSTMENT		-132	-198	-330
ADJUSTED TOTAL	16,258	16,218	-497	15,721

DEPARTMENT OF ENERGY

Proposed Appropriation Language

Energy Supply, Research and Development Activities

(Including Transfer of Funds)

For expenses of the Department of Energy activities including the purchase, construction and acquisition of plant and capital equipment and other expenses incidental thereto necessary for energy supply, research and development activities, and other activities in carrying out the purposes of the Department of Energy Organization Act (Public Law 95-91), including the acquisition or condemnation of any real property or any facility or for plant or facility acquisition, construction or expansion; purchase of passenger motor vehicles (not to exceed [17] 18 for replacement only), [$1,989,671,000] $1,254,162, to remain available until expended [of which $200,000,000]; in addition, $584,158,000 shall be derived by transfer from Uranium Supply and Enrichment Activities provided in prior years[, and of which $17,400,000 shall be derived by transfer from Operation and Maintenance, Southeastern Power Administration; and of which $25,000,000 shall be available only for construction of]: Provided, That funds available under this head in Public Law 99-141 for the Advanced Science Center, the Center for Science and Technology, the Center for Energy and Biomedical Technology, the Energy and Mineral Research Center, and the Demonstration Center for Information Technologies [as described in the report accompanying this Act; together with not to exceed $6,000,000, to be derived from revenues from activities of the Technical Information Services, which shall be credited to this account and used for necessary expenses and shall remain available until expended], shall be available for other expenses of energy supply, research and development activities. (Public Law 99-141, making appropriations for energy and water development, 1986.)

DEPARTMENT OF ENERGY
FISCAL YEAR 1987 CONGRESSIONAL BUDGET REQUEST
SUMMARY OF ESTIMATES BY APPROPRIATION BY MAJOR ACTIVITY
ENERGY SUPPLY RESEARCH AND DEVELOPMENT

(Budget Authority in Thousands of Dollars)

	FY 1985 Actual	FY 1986 Estimate	FY 1987 Request
Solar Energy	$ 171,587	$ 144,624	$ 72,292
Geothermal	29,698	26,681	17,930
Hydropower	447	481	---
Electric Energy Systems	19,717	11,548	7,619
Energy Storage Systems	18,642	17,292	8,600
Nuclear Energy R&D	412,612	375,684	330,900
Remedial Action & Waste Technology .	170,365	230,047	294,100
Civilian Waste R&D	25,886	16,064	6,500
Environmental, Safety and Health ...	38,053	46,921	76,098
Biological and Environmental Research	187,746	179,950	196,565
Liquified Gaseous Spill Test Facility	4,299	1,732	1,200
Magnetic Fusion	429,553	365,469	333,000
Basic Energy Sciences	410,800	433,770	441,370
Energy Research Analysis	2,970	2,598	3,550
University Research Instrumentation.	4,950	6,254	5,000
University Research Support	10,098	10,296	10,975
Advisory and Oversight Program Direction	2,900	2,674	2,900
Multi-Program Laboratories Facilities Support	33,200	39,824	60,190
Small Business Innovation Research Program	24,724	---	---
In-House Energy Management	14,821	11,709	16,500
Technical Information and Management	13,442	12,413	10,775
Policy and Management	3,380	3,497	3,887
Subtotal, Energy Supply R&D ...	2,029,890	1,939,528	1,899,951
Less Use of Prior Year Balances and Other Adjustment	-62,400	-243,230	-645,789
Total, Energy Supply R&D............	$1,967,490	$1,696,298	$1,254,162

Solar and Other
Renewable Energy

DEPARTMENT OF ENERGY

FISCAL YEAR 1987 CONGRESSIONAL BUDGET REQUEST

ENERGY SUPPLY RESEARCH AND DEVELOPMENT

VOLUME 2

SOLAR AND OTHER RENEWABLES

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Department of Energy
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Renewable Energy

PRINCIPAL RENEWABLE ENERGY ISSUES

Renewable energy based sources--solar, biofuels,wind, ocean, hydropower, and geothermal--presently account for about 8 percent of the energy consumed in the United States in 1984. In certain locations, the contribution of specific renewable energy technologies is even greater, e.g., 15 percent of all water heaters in Hawaii are solar, 8 percent of California's new electric generation capacity is renewable. As the various renewable energy technologies continue to develop, their economic and technological viability should improve and their collective contribution to the Nation's energy needs should continue to increase. Availability of this source of energy is thus a major element of national energy policy.

DOE's Renewable Energy Programs

DOE's renewable energy programs include a number of technology areas of potential importance to the nation's energy production, storage, and distribution network:

- Solar Buildings technology addresses the R&D associated with both active and passive solar heating and cooling, active domestic hot water heating, and passive daylighting.

- Photovoltaic technology converts sunlight directly into electricity through use of solid state electronic devices.

- Solar Thermal technologies focus sunlight on a receiver to produce electricity, heat, fuels, or chemicals.

- Biofuels technologies include the production of biomass feedstocks and the conversion of these and municipal waste into fuels.

- Wind energy technology employs a variety of technical concepts, including vertical axis turbines, horizontal axis turbines, augmenters, and contained systems.

- Ocean energy technologies use the thermal or kinetic energy stored in the oceans to produce electricity.

- Geothermal technology converts heat stored in geologic formations into useful energy. Four types of geothermal resources-- hydrothermal, geopressured, hot dry rock, and magma--are combined with several conversion technologies to produce useful energy as heat or electricity.

- Hydropower is the conversion of the kinetic energy of flowing water into mechanical or electrical energy.

- Electric energy systems supports research directed toward solving mid- to long-term problems in electric transmission and distribution, and incorporating new concepts and renewable energy resources into the utility network.

- Energy Storage supports advanced energy storage and electrochemical systems to facilitate the substitution of oil and gas fuels by coal, nuclear or renewable energy sources.

In 1974, when the federally supported renewable energy program began, most of these technologies were either in the conceptual stage or existed in rather primitive forms. Only solar water heaters, combustion of biomass materials and biogas digesters were in appreciable use in a few countries. Photovoltaic systems were used in space. Small wind machines to pump water and provide remote electrical output were commonplace in the early 1900's but had virtually disappeared in the 1970's. Only a few dry steam geothermal plants were in commercial operation. Use of woody biomass for the production of process heat and electricity especially in wood processing industries was well established. The only noteworthy ocean energy systems were small wave-power generators used for navigational buoys. Electric systems were small with only limited interregional interconnections, and only a few systems were equiped with any automated equipments for dispatching and management. Storage was conceptually defined but economics and reliability prevented its application.

During the past decade major advances have been made in all of the renewable energy technologies. New materials have been developed with the thermal, optical, and physical properties required for lower cost and higher performance. New components have been tested and substituted for less effective ones. Extensive systems analysis has been performed and hundreds of systems have been studied under both controlled laboratory conditions and typical field operation conditions. Teams of scientists and engineers in Government laboratories, universities, and industry have created a solid technology base and expertise in the extremely broad array of disciplines pertaining to renewable energy technologies.

The DOE estimates that renewable energy provided more than 8 percent of the primary energy consumed by the United States in 1982, primarily from direct combustion of wood, geothermal power, and hydropower. Renewable energy also represents more than 9 percent of indigenous energy production. The contribution of newer renewable energy technologies is more difficult to assess because their history in the marketplace is brief and statistically not yet significant. However, several indicators suggest that these technologies are already being recognized:

- Photovoltaic shipments increased from 2.5 MW in 1980 to over 12 MW--industry revenues are approximately $150 million.

- Small-to medium-scale wind turbines with total capacity of approximately 1,000 MW has been installed as of 1985.

- Some 800,000 to 1 million active water heating systems have been installed as of 1985.

- Geothermal electric systems provide in excess of 2,000 MWe and geothermal direct heating applications provide 60 trillion Btu per year as of 1985.

- Small-scale hydropower plants provide approximately 6,200 MWe from 1,153 plants.

- Direct combustion of wood currently contributes over 2.6 quads per year.

- Facilities for converting municipal waste to heat and electricity have risen from 7 in 1974 to 60 in 1985.

DOE projects that 13 percent of total energy consumption could be derived from renewable sources in 2010. Wood, geothermal, and hydropower are expected to provide most of this energy through the midterm, but newer technologies (e.g., photovoltaics, wind, solar building technologies, solar thermal power, advanced biofuels) should become significant at the national level during the 1990's. As renewable energy and other small scale or intermittent energy supply technologies become more prevalent, additional storage and control technologies will be required particularly as they relate to efficient and reliable management of the nation's electric energy system.

RENEWABLE ENERGY FRAMEWORK

Within the context of the National Energy Policy Plan, renewable energy sources can make a significant contribution to national energy needs. Renewable energy sources can complement conventional energy sources and can, through their diversity, reduce the impact of sudden energy supply interruptions or price increases in any single energy source. Renewable energy resources, where designed and constructed with appropriate storage and supply system interconnection technologies, can offer the flexibility of direct matching of various energy requirements with locally-available energy sources. The modularity of renewable energy equipment allows additions to be made in comparatively small increments, resulting in short lead time, reduced planning uncertainties, and comparatively small capital outlays. In rapidly changing and uncertain energy markets, this modularity offers significant economic benefits to energy producers and consumers.

A number of renewable energy technologies capable of providing these advantages are not yet a significant factor in the energy market. Additional R&D is required to accomplish and confirm the competitive viability of a number of these concepts while maintaining the integrity and safety of the nation's supply network. Long-term cost and demand projections indicate that many of these options represent attractive energy supply alternatives; however, the short-term outlook tends to discourage renewable energy investment by industry. Accordingly, continued Federal investment in renewable energy R&D appears prudent to ensure that a reasonable number of renewable energy supply options are available to the private sector in the long term. Additional factors influencing Federal investment in renewable energy R&D include:

- Early research breakthroughs often show enormous promise several years down the road. However, industry is frequently unable or unwilling to invest for an unknown or inadequately defined commodity. This is true of several renewable energy concepts where, despite remarkable initial success, a substantial amount of technical progress is still required before informed business decisions can be made regarding the individual technology options.

- The private sector frequently operates under a different set of decision criteria than does Government. One measure of this difference is in the time value of money used by industry and by Government. Heavy discounting typically employed in industrial decision making greatly reduces the value of long-term benefits relative to short-term results. Industry also views energy as just one input in the production process. Thus, industry will frequently reject investments unless they clearly offer nearer-term profits. Federal R&D investments may be justified in certain instances to encourage longer-term productivity and national returns.

- Individual private companies are rarely able to capture the full economic benefits of an investment in basic science or technology. Other companies often rapidly adopt a successful innovation and limit the company making the original R&D expenditure to a small share of the total market. This limits the willingness of individual companies to invest in certain types of long-term R&D. In the case of the technology options within this budget category, most may follow one of several possible technology development paths. Industrial investment often focuses on a single path in an area of proprietary interest that builds upon more generic investigations addressing broader areas of concern.

PROGRAM OBJECTIVES

The renewable energy budget category entails a broad variety of energy production, storage and distribution management technology which varies considerably with respect to verification of basic concepts and competitive viability. As a general rule federal funding is concentrated in basic and applied research and development which is conducive to informed decision making by the private sector regarding the development of a reasonably broad range of potentially competitive technology. Federal attention is concentrated on scientific and engineering research necessary to accomplish a better understanding of basic resource and technology phenomena, methods to employ these resources for producing competitive and useful forms of energy and important crosscutting technologies for storage of energy and for reliable and efficient management of the electric energy supply network.

Within this context, specific technology development objectives have been developed in collaboration with industry to ensure that federally funded research does not supplant research investments by the private sector and that federal investments are focussed on investigations most critical to advancing promising technology options towards confirmed competitive viability. Technology specific objectives vary somewhat according to the nature of the fundamental issues being addressed and the comparative definition of the technology involved. Guiding objectives for the federal effort therefore range from basic materials related issues such as the structural integrity of reflective surfaces or conversion efficiency of various photovoltaic or electrochemical storage materials; to resolution of wind technology reliability and durability issues through advancement of underlying structural and aerodynamic theory; to resolution of environmental uncertainty attendant to combustion of municipal wastes.

PROGRAM GUIDELINES

DOE has developed a generalized framework to uniformly assess multiyear applied research activities within each renewable energy technology.

The diversity of renewable energy technologies and the many storage and control mechanisms required for their incorporation into the energy supply network makes a uniform assessment of research and development programs extremely complex. While all renewable energy technologies ultimately depend on a renewable, frequently intermittent, energy resource such as wind or sunlight, a variety of conversion options (e.g., solar thermal systems, binary cycle geothermal) can produce one or more useful energy types, for example, electricity, fuel, and thermal energy which may be interfaced with various types of energy distribution and utilization networks.

As an example of the complexity of renewables, the various biofuels conversion options can collectively convert a wide range of organic matter into electricity, bulk solid, liquid or gaseous fuels, or direct thermal energy. However, the degree of current or potential viability of each option will vary regionally because of resource availability, technology performance, and regional demand profiles.

The varying degree of technical maturity of each option is a second source of analytical complexity. For example, some options, such as power generation using magma as a geothermal energy source, are still theoretical concepts. For this option, extensive research is required to determine the feasibility of using this energy source for power generation. Others, such as hydrothermal dry steam, represent commercial or near-commercial options, subject to only limited improvements through R&D advances.

Industry structure and maturity is a third important source of complexity. For example, in some instances an identifiable industry has established at least an initial market presence such as in solar water heating, and has developed the institutional and financial infrastructure to fund development and manufacturing. In other instances, no identifiable industry exists, as in the case of magma power, or an industry (such as electric utilities) exists but the capital and reliability constraints imposed on it tend to discourage adoption of innovative and risky technologies.

This complexity dictates an evaluation method that explicitly considers the unique aspects of each technology option, while maintaining consistency across all renewable energy technologies. The levels of Federal support requested for the various renewable energy technologies are based upon the results of this type of evaluation. This FY 1987 budget reflects a sound and stable commitment to the continuing development of these technologies. This proposal will increase understanding of the potential for virtually all of the most promising solar energy options and will substantially contribute to the base of technical information required for informed decisionmaking by the public and private sectors.

One of the primary goals of all the applied research areas in Renewable Energy is to effectively transfer technology from Federal and university laboratories to private industry. The earlier industry is involved, and the more directly that the research agenda is guided by the companies' own economic self-interest, the more effective the transfer is likely to be. A funding approach will be explored in 1987 as an effort to increase the private leverage of Federal funds, provide industry with increased involvement in the choice of technology development directions, and help limited Federal funds to support emerging industry more broadly. This approach is to solicit industry interest in joining together to form cooperative R&D ventures within broad sectors of the economy. This ultimately could transform most or all of the industry-performed work in Renewable Energy, and can facilitate transfer of advanced technology to the private sector. Many areas of industry-performed Renewables R&D work offer opportunities for this approach.
Cooperative ventures are potentially suited to this technology-transfer/proof-of-concept stage of activity. By law, and because of the competitive interests of the companies involved, their activity is restricted to precompetitive (i.e., not product-specific) research and development. The cooperative ventures would be designed to meet this criterion. This matches Administration policy of supporting longer-term generic research that benefits the public, but not using tax dollars to subsidize a particular company's development of proprietary products. Support of industry-cooperative R&D allows limited Federal funds to strengthen a whole industry and not just one or a few selected players. This could benefit emerging industries as well as more mature ones.

The voluntary organization of such cooperative ventures by industry would serve as a strong indicator for the proper direction of government-sponsored R&D. The pooled funding will also provide a greater degree of private cost-sharing for applied R&D, allowing Federal dollars to go farther.

If the cooperative venture is defined broadly, with a substantial membership base and level of funding, it can perform or sponsor technology development projects in a number of related areas. This serves to further reduce the risk to the participants, ensuring better chances for shared successes that will repay each party's investment.

The Department will not place tight constraints on the types of cooperative opportunities to be considered, but key characteristics of the concept include:

- Significant leveraging of Federal funding;
- The support that the Department would provide should not displace support that would otherwise come from the private sector;
- The Federal government will share in royalties or other repayment profits from the venture, proportionate to its contribution to the venture;
- Participation of two or more companies;
- Preferably ventures should include companies that have previously proven themselves successful in obtaining and managing co-funding from private sources.

As industry develops responses to this opportunity, the Department will consider reprogramming of monies to allow participation in promising cooperative ventures.

RENEWABLE ENERGY PROGRAM BUDGET

The levels of federal support in the budget for the various renewable energy, energy storage and electric energy systems technologies are considered appropriate given the appropriate Federal role and the need to progressively reduce federal budget deficits in light of the comparative needs and levels of federal funding for various other governmental activities. These levels of investment will provide for continuing progress in completing development of the technology base required for industrial decision making regarding these promising energy supply and management technologies.

DEPARTMENT OF ENERGY
FY 1987 CONGRESSIONAL BUDGET REQUEST
PROGRAM OVERVIEW

SOLAR ENERGY

The solar programs support research and development that will strengthen the technology base from which industry can draw in developing future new products and processes for commercial market development. The programs support activities ranging from basic research in universities and National Laboratories to applied R&D and proof-of-concept projects by the industrial sector. The FY 1987 budget request for Solar Energy is $72,292,000 which is a $72,332,000 reduction from the FY 1986 adjusted appropriation of $144,624,000.

Reductions in the Renewable Energy R&D programs are proposed in the 1987 Budget consistent with budgetary constraints. In addition, a new innovative cooperative R&D approach will be carefully reviewed and expressions of interest will be solicited from industry. Partnerships with industry-formed cooperative R&D ventures to support longer-term high-risk applied technology development of generic or precompetitive nature, may be an effective method to leverage Federal monies and increase program impact. This approach is intended to promote more effective technology transfer and to allow broader research support within current fiscal constraints.

The 1987 solar energy program will support generic and long-range research in a wide variety of alternative energy technologies, structured to provide a sound base from which industry can draw particular applications. The major areas being investigated, as in past years, are moderate and high-temperature solar heat, photovoltaics, biofuels, wind, ocean thermal energy conversion, and solar building technologies. The main research topics being pursued at universities and national laboratories within these application areas are materials sciences, aerodynamic/ fluid-dynamic modeling, biomass production and conversion technologies component system research, and thermodynamic cycles. Industry will be involved in applied research in these areas. In addition, funds are provided for technology transfer and international cooperative activities, generic resource assessments, and capital improvements at the Solar Energy Research Institute.

Prior Year and Recent Accomplishments

Solar Building Energy Systems

- Completed construction and testing of full-scale thin film polymer collectors with copper alloy absorbers and will complete evaluation and transfer of results to industry.

- Completed testing of the double-effect (2R) regenerative absorption chiller in the cooling mode and performed detailed analysis of the single-effect (1R) regenerative absorption cycle and will fabricate the 1R chiller.

- Completed testing of the heat pipe version of the Integrated Stationary Evacuated Concentrator (ISEC) collector and completed side-by-side testing of the new North-South oriented CPC collector.

- Completed testing of the half-scale parallel passage solid desiccant dehumidifier in the specially constructed test facility and completed testing of an advanced solid desiccant material.

- Completed a single family residential building design handbook for passive cooling load avoidance based upon ventilation and shading strategies.

- Completed the nonresidential passive solar experimental buildings program which shows passive systems supplying one-third to one-half the energy requirements at no additional cost.

- Provided design practitioners with a practical solution for daylighting single story nonresidential buildings.

- Developed multi-layered electrochromic optical switching materials for smart windows that control solar heat gains and losses.

- Completed encapsulation of new phase change thermal storage materials in conventional building materials thereby tripling their capacity for charging and discharging solar heat gain.

- Developed new low-conductance glazing materials and coatings which minimize window heat losses.

- Developed new holographic window films and light guides for enhanced daylighting deep in building interiors.

Photovoltaic Energy Systems

- Achieved 8% total area efficiency for an amorphous silicon submodule having an area of 1000 cm2 and an 11% efficient amorphous silicon solar cell.

- Achieved the growth of single crystal GaP on Si for a monolithic concentrator cell device.

- Developed a direct patterning process for solar cell contacts using laser beam surface activation. Electrolytic plating of silver onto the pattern completes the metalization system.

- Produced 50,000 cm2 of dendritic web silicon ribbon in one furnace in a growth cycle less than one weeks's time. At this point web ribbon will have an economic advantage over ingot and slicing technology.

- Developed and verified an analytical solar cell simulation model which correlates with experimetnal data to within 3%.

- Achieved a 26% efficient GaAs concentrator cell, a 25% efficient GaAs/SI stacked concentrator solar cell and a 20% efficient GaAs concentrator mini-module.

Solar Thermal Energy Systems

- Performed testing of a three meter diameter stretched membrane concentrator to establish membrane to frame coupling.
- Completed the first two years of the three year power production phase at Solar One.
- Completed molten salt component and subsystem experiments at the Central Receiver Test Facility in Albuquerque, New Mexico.
- Completed data evaluation of the first year of utility ownership and operation of the Shenandoah Solar Total Energy Project.
- Completed evaluation of the parabolic dish module and initiated construction of the Small Community Solar Experiment at Osage City, Kansas.
- Completed evaluation of the parabolic dish module selected for the second Small Community Solar Experiment at Molokai, Hawaii.
- Completed the comparison of solar thermal systems for electric power production.
- Concluded the hemispherical bowl project at Crosbyton, Texas.
- Completed the study of conversion options for Solar One and transmitted the report to the Congress.
- Initiated the transfer and consolidation of the central receiver systems program from Sandia National Laboratories-Livermore to the Sandia Laboratories-Albuquerque.
- Completed the first phase of the Innovative Concentrator contracts and initiated final design, fabrication and evaluation activities.
- Initiated cooperative management and research on Free Piston Stirling Engines with NASA/Lewis Research Center.
- Completed laboratory evaluations of thermochemical reactions and initiated tests of the most promising concepts for energy transport at the Distributed Receiver Test Facility in Albuquerque, New Mexico.
- Terminated support of Brayton cycle engines as not being capable of achieving near and long term program goals.
- Completed operations and maintenance evaluation of the Vanguard parabolic dish module (Advanco concentrator/United Stirling engine) at Rancho Mirage, California.

Biofuels Energy Systems

- Completed successful shakedown operations for 3000 kW combustor/gas turbine generator.

- Conducted full-scale combustion in an operating test facility to enhance MSW combustion efficiency and reduce emissions.

- Conducted laboratory testing of enzymatic hydrolysis to verify parametric analysis.

- Identified candidate short rotation woody species capable of genetic improvements in order to increase average yields of as much as 40 percent.

- Compared first growth yields with regrowth yields of short rotation woody species to document that regrowth yields are 20-100 percent higher.

- Analyzed the formation of trace organic substances (dioxins) during thermal conversion of municipal solid waste (MSW).

Wind Energy Systems

- Developed improved aerodynamic and structural codes to incorporate dynamic stall, turbulence and other unstead phenomena.

- Developed theories to predict effects of small-scale turbulence and initiate field tests investigation of innovative approaches to characterize it.

- Initiated testing of improved airfoils for intermediate size (200 to 600 kW) wind turbines.

- Completed design of 3.2 MW Mod-5 wind turbines.

- Completed variable speed operational testing on Mod-0 and transferred results to industry.

- Initiated a statistical data base on wind turbine fatigue, based with data from cooperative program and test turbines.

- Began design study for advanced horizontal axis test facility to replace the outdated Mod-0.

Ocean Energy Systems

- Completed design and procurement of the vacuum chamber for open-cycle seawater experiments and turbine test article conceptually defined.

- Completed data analysis and evaluation of the 1/3 scale down-the-slope cold water pipe (CWP) tests in Hawaii and developed 2D model to predict CWP loads.

- Completed the modification and test of a pneumatic wave energy conversion machine and initial studies on latent heat OTEC processes.

- Evaluated OTEC mixed effluent discharges using physical model.

- Performed open cycle direct-contact heat and mass transfer experiments.

- Completed detail design of the Seacoast Test Facility upgrade project.

Solar Technology Transfer

- Coordinated arrangements for referral of public inquiries to information and assistance services, including specific notices regarding the scope of responses provided by the DOE Conservation and Renewable Energy Inquiry and Referral Service, the Solar Energy Research Institute and its Technical Inquiry Service, the National Appropriate Technology Assistance Service, DOE's Technical Information Center, and the EIA National Energy Information Center.

- Coordinated the private publication of two books from the Solar Technical Information Program.

- Responded to approximately 40-50,000 public inquiries in FY 1985 on how to use energy conservation and renewable energy techniques.

DEPARTMENT OF ENERGY
FY 1987 CONGRESSIONAL BUDGET REQUEST
LEAD TABLE

Solar Energy
Energy Supply Research and Development
(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1985 Approp.	FY 1986 Approp. Adjusted	FY 1987 Base	FY 1987 Request	Request vs Base
Solar Energy					
Solar Buildings Energy Systems					
Operating Expenses	$8,985	$7,700	$7,700	$4,700	$-3,000
Capital Equipment	200	481	481	0	-481
Subtotal Solar Buildings......	9,185	8,181	8,181	4,700	-3,481
Photovoltaic Energy Systems					
Operating Expenses	45,169	39,523	39,523	19,600	-19,923
Capital Equipment	1,000	1,155	1,155	1,000	-155
Construction	8,480	0	0	0	0
Subtotal Photovoltaic.........	54,649	40,678	40,678	20,600	-20,078
Solar Thermal Energy Systems					
Operating Expenses	33,395	25,596	25,596	15,300	-10,296
Capital Equipment	500	289	289	0	- 289
Subtotal Solar Thermal........	33,895	25,885	25,885	15,300	-10,585
Biofuels Energy Systems					
Operating Expenses	29,031	26,749	26,749	11,600	-15,149
Capital Equipment	1,000	577	577	600	23
Subtotal Biofuels............	30,031	27,326	27,326	12,200	-15,126
Wind Energy Systems					
Operating Expenses	28,155	24,055	24,055	8,080	-15,975
Capital Equipment	200	770	770	170	- 600
Subtotal Wind................	28,355	24,825	24,825	8,250	-16,575
Ocean Energy Systems					
Operating Expenses	4,008	4,811	4,811	2,500	- 2,311
Subtotal Ocean................	4,008	4,811	4,811	2,500	- 2,311
International Solar Energy Program					
Operating Expenses	500	962	962	500	- 462
Subtotal International........	500	962	962	500	- 462

DEPARTMENT OF ENERGY
FY 1987 CONGRESSIONAL BUDGET REQUEST
LEAD TABLE
Solar Energy

	FY 1985 Approp.	FY 1986 Approp. Adjusted	FY 1987 Base	FY 1987 Request	Request vs Base
Solar Technology Transfer					
Operating Expenses	5,100	2,983	2,983	1,950	-1,033
Capital Equipment	0	0	0	50	50
Subtotal Tech. Transfer	5,100	2,983	2,983	2,000	- 983
Solar Energy Research Institute					
Capital Equipment	0	251	251	315	64
Construction	0	1,993	1,993	230	-1,763
Subtotal SERI	0	2,244	2,244	545	-1,699
Program Support					
Operating Expenses	1,000	1,251	1,251	897	- 354
Subtotal Program Support	1,000	1,251	1,251	897	- 354
Resource Assessment					
Operating Expenses	0	914	914	700	- 214
Capital Equipment	0	48	48	0	- 48
Subtotal Resource Assess	0	962	962	700	- 262
Program Direction					
Operating Expenses	4,864	4,516	4,516	4,100	- 416
Subtotal Program Direction	4,864	4,516	4,516	4,100	- 416
Total					
Operating Expenses	$160,207	$139,060	$139,060	$69,927	$-69,133
Capital Equipment	2,900	3,571	3,571	2,135	-1,436
Construction	8,480	1,993	1,993	230	-1,763
Solar Energy	$171,587	$144,624	$144,624	$72,292	$-72,332
Staffing - Total FTE	77	88	88	70	18

Authorizations:
- o P.L. 93-473, Solar Energy Research, Development and Demonstration Act
- o P.L. 93-577, Non-Nuclear Energy Research and Development and Demonstration Act
- o P.L. 95-390, Solar Photovoltaic Energy Research, Development and Demonstration Act
- o P.L. 95-911, Department of Energy Organization Act
- o P.L. 96-294, Energy Security Act
- o P.L. 96-310, Ocean Thermal Conversion Research, Development and Demonstration Act
- o P.L. 96-345, Wind Energy Systems Act

Department of Energy

FY 1987 Congressional Budget Request

Adjustments to FY 1986 Appropriaitons

	FY 1986 Conference	General Reduction	Management Initiatives	Pay Cost Restoration	FTE General Reduction	Gramm-Rudman-Hollings Reduction	Subtotal	Comparability Adjustments	Adj. Approp. Total
Solar Energy (CE)									
Solar Buildings Energy Systems									
Operating Expenses	$ 8,000	$ ---	$ ---	$ -163	$ ---	$ -300	$ 7,537	$ 163	$ 7,700
P&CE	500	---	---	---	---	-19	481	---	481
Subtotal	$ 8,500	$ ---	$ ---	$ -163	$ ---	$ -319	$ 8,018	$ 163	$ 8,181
Photovoltaic Energy Systems									
Operating Expenses	$ 47,800	$ ---	$ 6,470	$ ---	$ ---	$-1,807	$ 39,523	$ ---	$ 39,523
P&CE	1,200	---	---	---	---	-45	1,155	---	1,155
Subtotal	$ 49,000	$ ---	$-6,470	$ ---	$ ---	$-1,852	$ 40,678	$ ---	$ 40,678
Solar Thermal Energy Systems									
Operating Expenses	$ 26,600	$ ---	$ ---	$ -123	$ ---	$-1,004	$ 25,473	$ 123	$ 25,596
P&CE	300	---	---	---	---	-11	289	---	289
Subtotal	$ 26,900	$ ---	$ ---	$ -123	$ ---	$-1,015	$ 25,762	$ 123	$ 25,885
Biofuels Energy Systems									
Operating Expenses	$ 27,800	$ ---	$ ---	$ -11	$ ---	$-1,051	$ 26,738	$ 11	$ 26,749
P&CE	600	---	---	---	---	-23	577	---	577
Subtotal	$ 28,400	$ ---	$ ---	$ -11	$ ---	$-1,074	$ 27,315	$ 11	$ 27,326
Wind Energy Systems									
Operating Expenses	$ 25,000	$ ---	$ ---	$ ---	$ ---	$ -945	$ 24,055	$ ---	$ 24,055
P&CE	800	---	---	---	---	-30	770	---	770
Subtotal, Wind	$ 25,800	$ ---	$ ---	$ ---	$ ---	$ -975	$ 24,825	$ ---	$ 24,825
Ocean Energy Systems (OE)	$ 5,000	$ ---	$ ---	$ -37	$ ---	$ -189	$ 4,774	$ 37	$ 4,811
International Solar Program (OE)	$ 1,000	$ ---	$ ---	$ ---	$ ---	$ -38	$ 962	$ --	$ 962
Solar Technology Transfer									
Operating Expenses	$ 3,050	$ ---	$ ---	$ ---	$ ---	$ -67	$ 2,983	$ ---	$ 2,983
P&CE	50	---	---	---	---	-50	---	---	---
Subtotal, Solar Technology Transfer (P&CE)	$ 3,100	$ ---	$ ---	$ ---	$ ---	$ -117	$ 2,983	$ ---	$ 2,983
Solar Energy Research Institute (P&CE)	2,332	---	---	---	---	-88	2,244	---	2,244
Program Support (OE)	1,300	---	---	---	---	-49	1,251	---	1,251
Resource Assessment									
Operating Expenses	$ 950	$ ---	$ ---	$ ---	$ ---	$ -36	$ 914	$ ---	$ 914
P&CE	50	---	---	---	---	-2	48	---	48
Subtotal	$ 1,000	$ ---	$ ---	$ ---	$ ---	$ -38	$ 962	$ ---	$ 962
Program Direction	4,900	-161	---	-203	-41	-182	4,313	203	4,516
Subtotal, Solar Energy	$157,232	$ -161	$-6,470	$ -537	$ -41	$-5,936	$144,087	$ 537	$144,624

Department of Energy

FY 1987 Congressional Budget Request

Adjustments to FY 1986 Appropriaitons

Solar Energy (CE)	FY 1986 Conference	General Reduction	Management Initiatives	Pay Cost Restoration	FTE General Reduction	Gramm-Rudman-Hollings Reduction	Subtotal	Comparability Adjustments	Adj. Approp. Total
General Reduction (OE)	$ -161	$ 161	$ ---	$ ---	$ ---	$ ---	$ ---	$ ---	$ ---
Management Initiatives (OE)	-6,470	---	6,470	---	---	---	---	---	---
FTE Reduction (OE)	-41	---	---	---	41	---	---	---	---
Pay Restoration (OE)	-537	---	---	537	---	---	---	---	---
Useo of Prior Year Balances (Solar) (OE)	537	---	---	---	---	---	537	-537	---
Total, Solar Energy	$150,560	$ ---	$ ---	$ ---	$ ---	$-5,936	$144,624	$ ---	$144,624
Operating	$144,728	$ ---	$ ---	$ ---	$ ---	$-5,668	$139,060	$ ---	$139,060
P&CE	5,832	---	---	---	---	-268	5,564	---	5,564

DEPARTMENT OF ENERGY
FY 1987 CONGRESSIONAL BUDGET REQUEST
SUMMARY OF CHANGES
(In thousands of dollars)

Solar Energy

FY 1986 APPROPRIATION ADJUSTED	$144,624

Program increases and decreases

o Solar Buildings Energy Systems - Overall level of effort reduction in Solar Buildings Energy Systems research and development activities	(3,481)
o Photovoltaic Energy Systems - Overall level of effort reduction in Photovoltaic Energy Systems reserach and development activities	(20,078)
o Solar Thermal Energy Systems - Overall level of effort reduction in Solar Thermal Energy Systems research and development activities	(10,585)
o Biofuel Energy Systems - Overall level of effort reduction in Biofuel Energy Systems research and development activities	(15,126)
o Wind Energy Systems - Overall level of effort reduction in Wind Energy Systems research and development activities	(16,575)
o Ocean Energy Systems - Overall level of effort reduction in Ocean Energy Systems research and development activities	(2,311)
o Solar International - Overall level of effort reduction in Solar International activities	(462)
o Solar Technology Transfer - Overall level of effort reduction in Technology Transfer activities	(983)
o Solar Energy Research Institute - Overall reduction in plant and equipment for operation of SERI	(1,699)

DEPARTMENT OF ENERGY
FY 1987 CONGRESSIONAL BUDGET REQUEST
SUMMARY OF CHANGES
(In thousands of dollars)

Solar Energy

o Program Support	
- Overall level of effort reduction in Planning and Analyses	(354)
o Resource Assessment	
- Overall level of effort reduction in Resource Assessment activities	(262)
o Solar Program Direction	
- Reduce FTEs by 18	(416)
FY 1987 Budget Request	$72,292

	FY 86 Adjust. Appropriation	FY 87 Request	Net Change
Solar Buildings Energy Systems..................	$ 8,181,000	$4,700,000	$-3,481,000

The goal of the Solar Buildings Technology program is to advance the engineering and scientific understanding of solar energy, as applied to buildings, and to establish the technology base from which private industry can develop economically competitive solar-related products and designs for use in existing and new buildings. The FY 1987 budget request for Solar Buildings is $4,700,000, which is a $3,481,000 decrease from the FY 1986 adjusted appropriation of $8,181,000.

Research has confirmed that solar energy can be utilized to supply building energy requirements in a large variety of hot water, space heating, cooling and daylighting applications. Conventional building materials and components, as well as energy-related building systems, can be enhanced with improved thermal, chemical, optical and structural properties for the collection, conversion, storage and distribution of energy derived from solar resources. Innovative materials and components can achieve greater control of building heat gains and losses and provide enhanced daylighting at affordable costs and improved durability.

Materials and Components Research

Aperture and building materials research is aimed at improving building apertures to allow control over heat gain or loss. One area of activity aims to prevent heat losses by developing simple, safe and cost effective techniques for creating silica aerogel transparent insulating glazing materials, with minimum light scattering effects. Heat loss through apertures accounts for 25% of the total building heat loss. To control solar heat gain, research will continue towards the development of optical switching films for smart windows which will be durable and cost-effective. Research will continue in the development of holographic gratings which, when applied as film coatings for windows, will redirect daylight over thirty feet into buildings and for developing improved light guide which will transport natural light 50 feet into building interiors.

Thin-film polymer/foil flat plate collectors in the medium temperature range (140°F-180°F) for applications in water heating, space heating, and desiccant cooling systems. Research objectives include achieving efficiencies of 50% at 140°F with very low cost flat plate collectors constructed of thin polymer films and/or metal foils. Funds are requested for the following: (1) analytical and experimental investigations of several candidate ploymers to identify degradation mechanisms resulting from exposure to ultraviolet (UV) radiation, elevated temperatures, and moisture; and (2) evaluation of innovative design alternatives.

Evacuated tube compound parabolic concentrator (CPC) collectors. Research in this area builds upon previous work that resulted in the development of a very high efficiency, high temperature (200^{o}F-400^{o}F) integrated stationary evacuated concentrator collector with potential applicability in solar cooling and industrial process heating systems. Research is planned on advanced designs that incorporate suggested improvements based on design optimization studies. This includes materials research on high optical efficiency absorber coatings (stable up to 800^{o}F), research on alternative absorber designs and heat transfer fluids, and investigations of various fabrication techniques. Experimental testing of candidate designs to verify the achievement of performance objectives (efficiency = 60% at 350^{o}F); and to monitor operational characteristics (e.g., durability) is also included.

Thermal storage materials. Research directed at improving the thermal storage capabilities of conventional building materials will continue with scale-up tests for thermal performance, durability, toxicity, and reliability of materials, including alkyl hydrocarbons and polyalcohols.

Open-cycle absorption systems materials. The open cycle chiller research includes the analysis of several open-cyle system concepts, development of an efficient integral collector/regeneraton prototype, and evaluation of absorption chillers and refrigerant pairs suitable for this application. The operation and experimental evaluation of the prototype system will be undertaken as a part of this research effort.

Systems Research and Development

The Department of Energy has demonstrated that first generation solar buildings can be constructed for essentially the same cost as well designed energy conserving buildings, yet they consume only one-half to two-thirds of the energy. Initially, the program's goal is to extend this knowledge to the four building types that consume 65% of the energy in the nonresidential sector (offices, educational, health care, and retail/wholesale facilities), to multifamily buildings in the residential sector, and to rehabilitation/retrofit applications for all building types. To realize these goals, practical heating, cooling, and daylighting systems must be developed and tested. Research into new heating and cooling technologies and emerging materials and components must be developed, tested and then integrated into optimally functioning systems.

The specific FY 1987 activities that will be conducted are:

Systems research and development (nonresidential buildings). Research directed at providing the buildings industry with practical heating, cooling, and daylighting solutions for nonresidential buildings, in which practitioner confidence is effected through adequate documentation of predictability and proven performance. This would facilitate implementation of these technologies by the buildings industry. The research activities include: (1) Complete development of predictive and analytical tools that describe the energy performance of and occupant response to active heating and cooling systems; (2) Complete development of integrated cooling systems for low/mid rise buildings that utilizes thermal mass in conjunction with ventilative cooling and phase change storage materials; (3) Use validated predictive/analytical tools to develop strategies and controllers that optimally integrate solar building systems; and (4) Continue to monitor, analyze, and evaluate solar buildings systems to determine effectiveness, reliability, and maintainability.

Systems research and development (residential buildings). Research directed at the development of advanced active, passive, and hybrid heating and cooling systems capable of being integrated into the structural systems of multifamily and rehabilitation/retrofit buildings, and guidelines needed to design and integrate these systems with conventional and non-conventional space conditioning systems. This research addresses a need identified by industry for the residential buildings sector, which uses 60% of the energy consumed by buildings. It focuses upon the development of advanced technologies that meet the energy requirements of structurally complex and unique buildings for which existing technologies are inadequate. This research includes: (1) Continued analytical and experimental investigations, of advanced heating and cooling solutions; (2) Experimental analyses of multizone, multistory convective heat and mass transfer, their interaction with HVAC systems, and effect upon occupant comfort; (3) Initial development of guidelines needed to design advanced systems, including hybrid systems and distributed phase change storage materials; (4) Complete development of improved performance prediction and analytical tools; and (5) Continued collection and analysis of system effectiveness data to improve the reliability of solar systems.

Captial Equipment

No new funds are requested for capital equipment.

Photvoltaic Energy Systems

Adjusted FY 1986	FY 1987 Request	Net Change
$40,678,000	$20,600,000	-$20,078,000

The development of photovoltaics is keyed to advances in materials science and technology. Modules based upon crystalline silicon cell materials have been commercially available for a number of years and are now cost effective in high-cost electricity markets. In the past year thin-film amorphous silicon cells and modules have become commercially available from U.S. industries as a result of government/industry collaborative research efforts. This partnership with industry was responsible for re-establishment of a U.S. amorphous silicon research effort and continues in FY 1987 with a cost shared program for the advancement of the scientific base in amorphous silicon-based alloy materials.

In the longer term, it is projected that through cost shared research on thin-films and advanced high efficiency materials, higher-performance lower-cost photovoltaic power systems will become competitive with conventional electric power systems.

Research will emphasize single and multijunction alternatives across three major material groups. The first is amorphous silicon and the alloying elements of hydrogen, nitrogen, carbon, fluorine, germanium and tin. The second group includes high efficiency silicon and gallium arsenide concepts for application in flat-plate and concentrator collectors. Advanced thin film II-VI materials and compound alloy materials such as copper indium diselenide and cadmium telluride constitute the third materials research area. Research on performance, stability, and lifetimes of all three groups involves investigations ranging from material characterization and deposition techniques to module fabrication and test.

A more fundamental photovoltaic research effort will support university research and training, promote the development of new ideas, and explore innovative concepts in materials, device structures, conversion concepts, and characterization methods.

A focused technology transfer effort to assure that ten years of research information is used to the best possible advantage by industry and potential users will be undertaken through technical documentation, workshops and technical symposia.

The FY1987 budget request for photovoltaic energy systems is $20,600,000. This represents a $26,548,000 decrease from the FY1986 adjusted appropriation. Funds totaling $19,600,000 will be used to support the following research areas.

-- Amorphous Silicon for Single and Multiple Junction Cells: R&D activities will be conducted on issues important to cell performance, stability, and fabrication. The work encompasses material selection and characterization; deposition technology; characterization of films, surfaces and interfaces as a function of deposition parameters and methods; measurement of diffusion lengths, minority carrier lifetime, alloying characteristics, and surface and bulk recombination rates; modelling and analysis of materials and cell structures; and comparison with investigations of causes and remedies for light-induced degradation of amorphous silicon cells. Special emphasis will be on multiple-junction amorphous silicon devices using alloying elements including hydrogen, nitrogen, carbon fluorine, germanium and tin. Multiple-junction (stacked) photovoltaic devices offer the possibility of achieving higher efficiencies than single-junction devices. The additional efficiency may more than offset expected additional complexity and thus result in potentially less expensive energy production. These devices will be fabricated as monolithic stacks.

-- High-Efficiency Research: Although the theoretical conversion efficiencies of silicon cells and (III-V)-based cells are greater than 25 percent, the typical value for these materials is less than 20 percent. This activity will support materials, device and modelling research to achieve longer-term one-sun efficiency objectives of 22 percent and 27 percent, for silicon and gallium arsenide, respectively. It will also support research on high-efficiency multiple-junction concepts having the potential to achieve 25 to 35 percent cell conversion efficiencies for application in flat-plate and concentrator collectors. The high-efficiency cell concepts are largely based upon single-crystal, thin-film materials stacked vertically as grown or as placed in a mechanical configuration. The current state of material purity, deposition equipment and interface effects and techniques are all scientific challenges to be resolved. Modelling studies and theoretical analysis are required to guide the device research and the much-needed increases in advanced cell efficiency.

-- Advanced Thin-Film Devices: Single-junction polycrystalline thin-film cells have received federal and industrial R&D attention during the past ten years. Conversion efficiencies of a number of thin-film cells have doubled during this time, but have not reached their projected practical potential. Many R&D opportunities need to be explored to obtain higher-performance (e.g., conversion efficiency, stability and lifetime) and lower-cost cells and modules. Advanced thin-film materials showing the most promise include: copper indium diselenide ($CuInSe2$) and cadmium telluride ($CdTe$). The improvements of single-junction cells will be applied to the development of higher-efficiency, multiple-junction cells, which are often based upon combinations of the same materials. The program will continue to support research to produce improved heterojunction (junction formed between two different materials) and homojunction (junction formed by adjacent layers of the same material with different doping) devices based upon compound semiconductor materials. The longer-term goal of more than 15 percent laboratory cell conversion efficiency by 1987 is expected to be met under this project.

-- Photovoltaic Fundamental Research: The objective of this program element is to support university research and training, promote the development of new ideas, and explore innovative concepts having significant interest and potential impact on photovoltaic science and technology. This thrust is aimed principally at projects and efforts expected to make substantial long-range contributions to the advancement of photovoltaic conversion through coordinated basic and applied research conducted by universities in support of the national program goals. Particular attention will be given to the needs of universities in fulfilling their missions and in creating conditions promoting their maximum contributions to the photovoltaic technology base. Research, new ideas and innovative concepts are expected to include new semi-conductor materials, device structures, conversion concepts and characterization methods.

-- Technology Diffusion: The National Photovoltaic Program has amassed a wealth of information from materials to systems during its ten years of research and development. This activity is a focused effort to assure that such research information is used to the best possible advantage by the industry and the user. Through technical documentation, workshops and technical symposia, information will be transferred and further research identified that will bring photovoltaic technology to competitive maturity domestically and internationally.

Capital Equipment

Funds totaling $1,000,000 are needed to upgrade and procure equipment for the Solar Energy Research Institute (SERI) and university laboratories. This equipment is needed to implement (a) new measurement techniques to analyze and evaluate materials and device structures, and (b) improved deposition methods for laying down controlled thin-films of materials to formulate new thin-film devices. In particular, these funds will help maintain SERI at the forefront of photovoltaic materials characterization.

	FY 86 Adjust. Appropriation	FY87 Request	Net Change
SOLAR THERMAL ENERGY SYSTEMS	$25,885,000	$15,300,000	-$10,585,000

The goal of the Solar Thermal Technology program is to advance the engineering and scientific understanding of solar thermal technology and to establish the technology base from which private industry can develop solar thermal power production options for introduction into the energy market. The FY 1987 budget request for Solar Thermal is $15,300,000, which is a $10,585,000 decrease from the FY 1986 adjusted budget of $25,885,000.

Through concentration and heat absorption, solar thermal energy can be converted into electricity or incorporated into products as process heat. Highly reflective surfaces or refractive lenses are arranged geometrically to focus on a receiver which converts the radiant energy into transportable heat. Solar thermal technologies can supply energy for applications over a broad range of sizes and temperatures. Solar thermal energy can also be stored, extending useful operation into non-daylight hours. Another option is hybridization using a fossil fuel combustion source, which increases reliability and offers the benefit of constant power output even at low levels of insolation.

The "National Solar Thermal Technology Program, Five Year Research and Development Plan" outlines federal research activities that will be pursued to achieve the needed technology base from which industry can choose appropriate solar thermal energy options. This plan provides the basis for solar thermal technology planning and reporting. The plan identifies eleven research tasks in three major areas; collection, energy conversion, and systems and applications. The tasks are designed to achieve technical improvements in the most promising solar thermal concepts. With the maturity of the technology progressing well, the Solar Thermal Program is in a position to encourage cooperative venture research and development projects. Three specific collaborative activities to be to be continued in FY 1987 are the development of stressed membrane distributed concentrators (parabolic dishes), scaled up central receiver molten salt receivers and automated control systems.

Collection Technology Research

The energy collection process consists of the concentration and transmission of sunlight by a concentrator such as a heliostat (for central receivers), parabolic dish, parabolic trough, fresnel lens, or other optical concentration device, to a receiver where the sunlight is converted to thermal energy. The collection technologies research areas are; optical materials, concentrators, and receivers.

The objective of this research is to identify and characterize, collection materials and components suitable for stable long-life performance in concentrating solar applications. Concentrating solar thermal technologies have great potential for inexpensive energy production. To better realize this potential; light-weight, high performance reflectors, high-temperature receivers, and concentrators must be evaluated.

The specific FY 1987 research activities that will be conducted are:

- Optical Materials

  Research in optical materials includes identification and characterization of reflecting materials; fundamental evaluation of the failure mechanisms of optical surfaces, degradation mechanisms in polymers, high-absorptivity coatings, high-temperature measurements; and research on refracting optics to determine optical requirements and the appropriate tradeoffs between cost and useful life. The objective is to develop a lightweight reflector that is of comparable quality to a glass mirror. In particular, this means a reflector over 90% reflectivity with a useful life over 5 years. This will be accomplished primarily through research on silvered polymeric reflector materials and a front surface mirror concept where the silver is protected by a solgel compound.

  Concentrators made of silvered polymers or silvered stainless steel have the potential for a substantial reduction in the weight and thus the cost, of the single largest capital cost item of solar thermal systems. The requirement of high-specularity and long-term UV protection is a requirement which is unique to the solar thermal program. This materials research area is aimed at understanding the relationship between the solar flux and the polymer, silver and sol gel. The polymer and sol gel must then be modified to protect the silver reflective surface. Chemical interactions between the silver, polymers, sol gel and stainless steel must be understood and eliminated. Accelerated testing is underway to understand the degradation of polymers from ultraviolet radiation as well as from other environmental factors.

- Concentrators

  Solar concentrators for central receivers, parabolic dishes or parabolic troughs comprise 35-50% of the cost of the system. Maintaining performance while decreasing the cost of concentrators is the biggest single opportunity for bringing the financial risks of solar thermal systems down to a range where private industry can assume control of development. Decreasing the weight of the concentrator has a direct relation to decreasing its cost. Much of the effort in this task focuses on understanding materials' properties, developing mathematical analyses and conducting performance and environmental testing of concentrators to verify those analyses. This effort, done in conjunction with industry, is to determine if the concepts are approaching the multi-year program objectives.

  The specific objective is to decrease the weight of concentrators by at least 55% while increasing the annual efficiency by 5%. The principle concentrator concepts to be investigated include silver/polymer and silver/ stainless membranes and Fresnel lenses. Sufficient progress has been made that it should be possible to use an industry cooperative venture for the development of attractive parabolic dish concentrators. Important in these tasks is gaining an understanding of the force between the new lightweight reflector materials being used and the structures supporting them at various loading conditions. Research will also explore methods of reducing the wind load on a field of concentrators, particularly heliostats and parabolic dishes, through analysis and wind tunnel modelling. Testing and evaluation of stretched membrane heliostats and dishes and innovative point focusing concentrators, began in FY86, will continue.

o Receivers

Solar receivers represent the highest technical risk area in central receiver solar thermal systems. Important heat transfer and thermal cycling data concerning receivers is not well understood: making them both heavy and costly. This task aims at better identifying thermal cycling and loss mechanisms, which will lead to improved thermal and structural designs. The objective is to decrease the technical risks and thus the cost of receivers, principally for central receivers, while maintaining or increasing their annual efficiency. In order to do that, several significantly differing concepts must be evaluated.

One concept is the "optimum" receiver. This concept integrates the thermal analysis on tube and cavity receivers with the lessons learned from the Barstow Solar One and Molten-Salt experiment receivers. This optimum receiver, designed in FY86, incorporates significant changes to reduce technical risks and expands the state-of-the-art in receivers. Testing will be initiated at the CRTF during FY87 and/or at Barstow in FY89. This is another area that offers the possibility of pursuing a cooperative research and development venture. Previous cooperative development projects in this category have been performed on pumps, valves and smaller scale receivers. One highly advanced concept being evaluated is the direct absorbing receiver in which the solar energy is absorbed directly into the working fluid without need of tubes. Such a concept has the potential to increase the efficiency while significantly reducing the material risks of thermal expansion and cycling and the cost of receivers. The concept also has the potential for working at temperatures up to 900±C. Receiver evaluations will consist of thermal modeling to quantify convective and radiative losses, design receivers and conduct preliminary testing at the CRTF.

This task also supports an area of research that may lead to better utilization of the concentrated solar flux. Combustion receiver/reactors will take advantage of high energy photons to initiate certain chemical reactions and the remaining portion of the solar spectrum will provide the heat necessary to complete the reaction. Thus, this task addresses both the need of reducing the risks and the need for broadening the applicability of solar thermal systems.

Energy Conversion Technology Research

The objective of this research is to identify processes and components to convert thermal energy into electricity or other usable energy forms such as fuels and chemicals. It includes thermal or thermochemical processes for transporting energy, and also thermal and chemical energy storage.

The specific FY 1987 research activities that will be conducted are:

o Heat Engines

Heat engines convert the concentrated solar energy to electricity. The efficiency of the engine is the largest contributor to the overall system efficiency. The engine is also, because of its rotating parts, the most likely part of the system to break down. For the longer term, this task addresses these problems through research into new concepts: which are direct conversion engines with high-efficiency and high-reliability. Although heat engines are used in central receiver system this task area deals primarily with heat engines for parabolic dish mounted applications because of critical problems in that application.

The objective of this research task is to reduce the expense of dish mounted heat engines below $400/kWe while increasing the annual system efficiency to 25%. It appears that current engines, (organic Rankine, Brayton, and kinematic Stirling cycle) cannot meet the program goals and emphasis has shifted to new advanced engines. The principle engines to be studied are the free-piston Stirling engine, the sodium heat engine (SHE) and the regenerative thermo-electrochemical engine (TECH). These devices convert the sun's energy to electricity with almost no moving parts. All are highly efficient and have the potential for low operating, maintenance and capital costs. In addition, they operate over different temperature ranges which makes it possible to combine two engines to provide an overall efficiency (heat to electricity) of nearly 50%. Research will continue to determine their technical feasibility and on integrating them into solar systems. Technical problems will have to be solved in system control, short-term energy storage, and containment materials.

Additional tasks will continue evaluations of organic Rankine and other engines [illegible] needed to support the testing phase of the Small Community Solar Experiments at Osage City and Molokai. This support will insure that the experiments are successful. Since these engines are still in the development stage it is anticipated that they will have periodic maintenance problems, such as oil or gas leaks, bearing failures, or control breakdowns that need to be addressed.

o Direct Conversion Devices

Solar thermal systems have been used to convert concentrated solar energy into heat which is then used directly for an industrial process or converted into electricity via a heat engine. Preliminary research has indicated that other (perhaps unique) characteristics of concentrated solar flux can result in other high value applications. This research does not degrade all of the solar spectrum to heat, but separates the high energy photons for direct use. It is expected that this small percentage of the spectrum will have a large effect on many processes. Most of the spectrum is still used to produce heat for an endothermic type of reaction.

The objective of this research task is to more completely utilize the unique properties of concentrated solar flux. High energy photons in the UV and near-UV portion of the spectrum may be able to initiate a variety of chemical reactions not possible by other sources of energy. This, and other unique properties of concentrated solar flux, may provide new applications for solar thermal systems. Research will continue into the basic interaction of flux on materials and various chemicals in order to determine how the energy is transferred. In addition, research will continue to determine if the very high heat transfer rates produced by solar thermal systems can benefically alter the reactant path of chemical reactions. Examples of the applications being studied in this task include the solar detoxification of hazardous organic wastes and the photo-catalytic formation of ammonia from air and water. These would be entirely new applications of solar thermal energy: the direct coupling of the flux to the chemical reaction. Related research is also conducted to shift and separate the solar spectrum so those particular portions that are most beneficial to a particular reaction can be maximized and used efficiently.

o Transport and Storage

Solar energy is intermittent and periodic by nature. Storage allows the system to operate continuously during cloudy periods and additional storage can extend the period of operation into night-time hours. Long-term storage is important because it allows solar systems the flexibility to meet the needs of the user: whether it be a chemical plant or utility. As long as solar systems can operate efficiently only during daylight hours they will have a sharply restricted applicability. Thermochemical processes offer the potential for an efficient storage and transport that would greatly enhance the efficiency and flexibility of solar thermal systems.

The objective of transport and storage research is the evaluation of transport and storage systems that can provide an effective match between the fluctuating solar energy resource and the thermal, electrical or chemical load demand. The two primary methods of energy transport and storage are thermal and chemical. This task in FY87 is concerned primarily with chemical transport and storage. Chemical storage/transport has the advantage in that the chemicals are stored and transported at ambient temperature, thus eliminating much of the thermal losses.

The key to the feasibility of this is the efficiency of the endorthermic reaction at the solar receiver and the exothermic reaction at the point of application. Research during FY87 will determine these efficiencies through the test of experimental reactors. Depending on studies conducted in FY86 either the CH_4/CO_2 reforming or SO_2/O_2 reactions would be used. Problems that must be addressed include catalyst degradation, thermal cycling of materials and control of side reactions. An additional task in the thermal storage area looks at methods of reducing the risks of transporting and containing high-temperature molten salt from central receiver applications.

Systems & Applications Technology Research

The objective of this research is to conduct system evaluations and parametric and comparative analysis at an early stage to assess the potential of alternate concepts, and to define critical technology and component issues. This research effort includes the evaluations of existing designs, components, subsystems and systems. Support for scientific and engineering experiments are included as necessary to achieve program goals.

Research areas include: 1) the assessment of innovative concepts and applications; 2) balance-of-plant components; 3) the analysis, design, and experimental testing of central and distributed receiver subsystems and systems at research facilities and also: 4) support for the design, construction, operation, and evaluation of complete systems at user locations.

The specific FY 1987 research activities to be conducted are:

o Balance of Plant

Reducing operating and maintenance requirements are critical in solar thermal systems. This becomes increasingly important as the size of the plant decreases. For a small solar thermal plant to be economically competitive, unattended operation and monitoring is probably necessary. This task is intended to address that issue by applying state-of-the-art artificial intelligence technology to solar thermal systems. This task also studies the maintenance requirements of the systems to keep the plants operating at maximum efficiency and reliability.

The objective of this research task is to minimize the risk and expense associated with the operation and maintenance of solar thermal systems; principally through the development of innovative maintenance approaches and control systems that would allow for unattended operation. Rapid advances in electronics and artificial intelligence makes it possible for state-of-the-art sensors and computers to monitor and control the thousands of heliostats or parabolic dishes and other components and subsystems that make up a solar system. Experimental control systems will be designed and evaluated to support the Small Community Solar Experiments and the central receiver system experiments at the CRTF. These applications are representative of small dish and central receiver systems and are likely to be cooperative venture projects with industry cost sharing. Maintenance concepts, such as concentrator cleaning methods, improved heat tracing, and more routine maintenance requirements, will be evaluated to improve system performance and reliability.

o Central Receiver Systems

The general objective of this research task is to determine the technical applicability of small-scale central receiver experiments to full size systems. Testing of small-scale hardware is vitally important to provide solutions to "real world" problems that do not show up in the laboratory environment. It is through these tests for example, that many materials problems first surface. These tasks also give industry and utilities confidence that the technology is appropriate to their application. The ability of the researchers to prove the scaleability of their test results to larger systems is key in convincing these users that the technical risks are understood and can be overcome without further scientific breakthroughs. This task is thus a form of technology transfer from government to industry of central receiver hardware concepts that have proven to be technically feasible.

Central receiver system research activities include the development of designs, the analysis of system parameters and the experimental testing of groups of components, leading to the evaluation of prototype subsystems and systems. To support these objectives small scale experiments of central receiver components and subsystems will be designed and conducted at the CRTF to verify such items as the scaleability of heat losses, heat tracing and receiver tube. Mathematical analysis, including computer code development, will integrate advanced components into a system for concept comparison and to provide guidance for future research. One such study, completed in FY86, determined the feasibility of high-temperature systems. This study for example influenced the direction of the task on "Receivers". Another major activity will be tradeoff and conceptual studies to support the determination of the next appropriate step in central receiver technology.

o Distributed Receiver Systems

Laboratory tests are not able to exactly simulate the solar spectrum nor the environmental conditions that field hardware must actually withstand. Tests at the DRTF are thus valuable from a diagnostic point of view. Hardware performance is also used to verify the mathematical analyses and computer codes that were used in each design stage. This correlation of theory and working modules is a key factor in convincing industry and utilities that the technical risks are understood and can be overcome.

The objective of this research task is the verification of mathematical analyses of distributed receiver systems (dishes and troughs) through laboratory and DRTF testing and evaluation. The dish module for the Small Community Solar Experiment at Molokai, Hawaii will be tested during FY87 before it is approved for Molokai. Analyses will be conducted comparing the performance of dish modules to the requirements for reflector accuracy, and structural rigidity, and the usefulness of terminal concentrators for a variety of operating temperatures.

o Systems Experiments

System experiments at user sites provide data on capital and O&M costs, performance, reliability and operations and maintenance techniques and problems of solar thermal systems. Experiments are conducted with significant cost-sharing from equipment manufacturers and potential users. Such experiments support the achievement of technical and economic feasibility and are intended to provide the final impetus for industry to commit to full development of the technology.

The objective of this task in FY 1987 is to evaluate data generated from system experiments at the Solar One Pilot Plant at Barstow, California and the Small Community Solar Experiments at Osage City, Kansas and Molokai, Hawaii. This data provides valuable insight into the long-term material and component problems that may not have been predicted in laboratory tests or prototype evaluations. Most of the funding in this task is the DOE contribution to the Solar One cooperative agreement for operations and maintenance of the facility.

Planning and Assessment

The objective of this activity is to conduct program integration, assessment, comparative analysis and specific technology transfer activities such as program documentation and periodic contractor review meetings. Solar thermal activities will be continued to support implementation of the Five-Year Research Program Plan.

	FY 1986 Adj. Approp.	FY 1987 Request	Net Change
BIOFUELS ENERGY SYSTEMS	$27,326,000	$12,200,000	$15,126,000

The goal of this program is to conduct a balanced research effort aimed at providing the generic technology base for industry in the areas of feedstock production and conversion. The objective is to provide early transfer of technology to the private sector by verifying technical feasibility/readiness of combined feedstock production and conversion technologies through cost-shared projects.

The purpose of Short Rotation Intensive Culture research is to establish the technology information base needed to enable the private sector to increase the production of wood energy feedstocks in targeted areas using short rotation intensive culture (SRIC) of woody plants. The objective of increasing potential productivity will be approached through genetic improvement combined with advances in innovative cultural management strategies. Biological evaluation of management alternatives includes evaluation of stem regrowth (coppice) following harvest and assessment of disease and pest risks. The objective of improving the technologies of SRIC will be addressed in FY 1987 through identification of efficient cultural strategies using improved genetic material and through evaluation of nutrient conservation mechanisms. Analyses indicate that SRIC of woody plants is a technology which once developed by the private sector has the potential to supply wood users with an assured, sustained wood supply at competitive prices and without Federal subsidies in areas where it is most needed.

Genetic improvement of species offers the greatest potential for increasing the productivity of SRIC. Classical genetic selection for new, highly productive families and energy clones will continue. Researchers believe that additional productivity gains of up to 90% are possible through genetic improvement. Candidates have been selected for genetic selection and future hybridization.

Prior research indicates that coppicing results in productivity gains of at least 30%. However, additional data are needed to verify that stands can be cut repeatedly without loss in regenerative power. Coppice evaluations will be examined on established test plots. These management techniques will be evaluated, and species or clones that show the best generation-based coppice potential will be identified. Data will be simultaneously obtained on techniques for increasing coppice growth and optimum number of harvests. Successful coppice growth is a major key to viability of SRIC.

Monoculture viability studies will be conducted to determine the biological risks of growing single species of trees under intensive culture conditions. In particular, susceptibility to diseases and pests will be identified, and operational yields will be determined. Industry is expected to cost-share equally in these experiments.

Nutrient conservation studies will address the environmental concern of SRIC-caused nutrient depletion on marginal agricultural land. Quantification of nutrient cycling mechanisms under a series of management approaches will be conducted to determine the best management regime for reducing costs and maintaining site productivity over the long term. Critical nutrient elements will be identified and ameliorative strategies evaluated.

The purpose of Herbaceous Energy Crops research is to provide the technology base that will allow the private sector to develop commercially viable systems for producing herbaceous biomass for fuels and energy feedstocks. The program focuses on lignocellulosic crops versatile feedstocks for biochemical and thermochemical conversion systems. In addition, effort will be devoted to oilseed crops. Analysis has indicated that herbaceous energy crops grown on marginal lands have high potential for a significant energy contribution and is a research area of high priority.

The goal of the Herbaceous Energy Crops program is to obtain yields of up to 12 dry tons/acre/yr. Experiments designed to select species or cultivars with high productivity on marginal croplands and to define promising approaches to production systems will be performed. In addition, experiments on the use of in-vitro systems for selecting and improving species for use on sites with specific chemical or physical limitations to production will be conducted.

In FY 1987 oilseed crop research emphasizes breeding and testing of new varieties of winter rapeseed for liquid fuels. Resistance to the herbicide atrazine will be bred into varieties of winter rapeseed whose fatty acid composition has been adjusted to maximize the fuel value, permitting the control of weeds related to rapeseed in rapeseed fields. Limited variety trials designed to establish planting dates, harvesting dates, and yields for rapeseed varieties will be evaluated.

The purpose of Aquatic Species research is to improve the productivity of microalgal species, and the efficiency of conversion processes for these species, to the extent that private industry will develop these technologies for liquid fuels. Microalgae are widespread in nature, possess rapid growth characteristics and diverse chemical composition, and provide a potential resource base for producing renewable fuels. Microalgae production is designed to provide a domestic source of high-energy liquid fuels, such as gasoline and diesel fuels, which complement and contribute diversity to the nation's overall energy mix. Research will focus on selecting and improving strains of microalgae to provide high, sustainable yields of fuel products in outdoor mass culture.

FY 1987 funds for microalgae will be used for those research areas identified as critical for further advancement of the technology: species screening, species improvement and outdoor culture strategies. In the species screening area, effort will be directed to complete characterization of strains for lipid yield, growth potential, and environmental tolerance. Carefully characterized strains will lead to selection of species on which to concentrate species improvement activities. The critical issues are: isolating species which possess high growth rate and high lipid production and isolating organisms with high growth rates at low temperature.

One goal of microalgae research is to improve lipid production from 20-30% of the organism by weight to 50-60%. In an effort to produce strains of microalgae with the ability to produce a larger percentage of lipids, research into the regulation of lipid synthesis will be conducted.

Mass culturing of microalgal species in small outdoor experimental facilities is imperative to the advancement of this technology. The objectives of this research are to verify the performance of laboratory-selected species in an outdoor setting and to devise strategies for maintaining high yields of lipids in the mass culture environment. Sensitivity to temperature and light are critical variables.

Thermochemical conversion will focus on the production of liquid fuels from biomass and the thermochemical processing of municipal solid waste. Liquid fuels have higher energy density than biomass feedstock and are able to be transported more economically and to be more easily stored. Liquid fuels also match existing end-use patterns, particularly in the transportation sector. Research in this area will be directed at identifying reaction pathways and methods for producing high-value liquids fuels and on improving yields and quality of liquid fuels. Municipal solid waste (MSW) research will continue to address the production of liquid and gaseous fuels by thermal processes, as part of the overall goal of assisting industry develop sound technologies for the productive use of municipal wastes.

In FY 1986 a major thrust of the biomass portion of this program element dealt with medium-Btu gasification. An industrially cost-shared experimental facility of 50-200 tons/day capacity will be constructed with FY 1986 funds and serve as a centerpiece for medium-Btu gasification. Industry is expected to assume responsibility for further applications development.

In the liquid fuels research area, fast pyrolysis and pressurized catalytic liquefaction will be evaluated in continuously-fed bench scale reactors and in process research units. This research will provide important information required for determining some of the necessary process conditions and expected yields of biocrude oils. The concept of fast pyrolysis has emerged as a promising alternative for producing liquid fuels. Using rapid heating rates, yields of gases and liquids as high as 95% can be produced. These products contain up to 20% high-value olefinic products such as ethylene and aromatics such as benzene, toluene, and xylene, which are potentially useful as fuels and octane enhancers. The pyrolysis research will focus on investigating extremely fast pyrolysis to maximize yields of high-value octane enhancers improving the yields of fast pyrolysis by conducting the reactions in an atmosphere of a reactive gas, and using fast pyrolysis to produce high yields of fuel oil substitutes.

Laboratory research will be conducted on the thermal stabilization of pyrolysis liquids with emphasis on reaction concepts for manipulating the decomposition reaction mechanisms of these unsuitable oils to prevent polymerization into heavy tars. Experiments will examine those process conditions which contribute to the production of paraffinic hydrocarbons in the desired boiling range in preference to the aromatic hydrocarbons.

The pressurized catalytic liquefaction research focuses on using a unique extruder/mixer design to investigate direct conversion of biomass to liquid fuels. This research will also provide the necessary feedstocks for research on refining these oils into gasoline compatible fuels.

Municipal solid waste research will focus on developing basic kinetic data for thermal liquefaction and gasification. The research is aimed at defining the primary and secondary chemical reactions, identifying some of the important operating parameters and how they influence the reactions, and producing a useful kinetic model that can be used by industry for design of efficient reactors to produce gaseous or liquid fuels. The scientific basis of heat transfer in MSW will be examined in order to establish fundamental data necessary for the design of efficient reactors.

FY 1987 funds will also be used to examine the most serious current problem in the implementation of emerging MSW thermochemical technologies as identified by industry, i.e., the understanding and control of trace chlorinated hydrocarbons. Research will address the understanding of chlorine sources, conversion and destruction of trace pollutants and, as an added energy bonus, the understanding of the combustion kinetics of MSW which is expected to lead to a 5% increase in the efficiency of waste-to-energy processes. In the MSW feedstock preparation area, research will focus on integrated models of preparation systems and the development and testing of suitable binders. The successful development of refuse-derived-fuel (RDF) from MSW will lead to cofiring of RFD in existing boiler facilities.

Research in biochemical conversion will be performed to provide the technology data base for conversion of cellulosic and lignocellulosic materials from renewable resources into high-value liquid and gaseous fuels. Effort will focus on the biology of microbial processes for enhanced product yields, high conversion efficiencies, and rapid kinetics of reactions, all of which will contribute to viable processes for alcohol fuels and methane-rich gases. Funding in FY 1987 for alcohol fuels will advance the technology for competitive production of octane enhancers and additives for transportation fuels. Further developments in alcohol fuels research have the potential to lead to neat transportation liquid fuels competitive after the turn of the century. The anaerobic digestion of dedicated feedstocks, biomass grown specifically for the digestion process, and municipal solid waste are high risk research areas with potential for significant pay-off. FY 1987 funds will be used for anaerobic digestion research to reduce the technical risks and enhance private sector involvement. Increased conversion efficiencies, improved rates of digestion and fermentation, and better pretreatment methods are research areas where improvements are targeted to sufficiently reduce risks to attract private sector investments.

FY 1987 ethanol production research will focus on conversion of the hemicellulose fraction of wood to ethanol, improvements in the yield of ethanol from cellulose, and conversion of lignin to liquid fuels. Available yeasts cannot convert the five carbon sugars present in hemicellulose to ethanol. Genetically modified yeasts to perform this conversion will be examined, potentially increasing the ethanol yield by about 40 percent per unit weight of wood processed. To improve the performance of enzymatic hydrolysis, chemical pretreatments will be tested to determine their ability to improve the conversion efficiency in various hydrolysis/ fermentation schemes. Research will be directed at cellulose enzymology to increase the productivity of enzyme producing organisms and, furthermore, increase the activity of the enzymes produced. This work will also include research on enzyme recycle. Increasing enzyme productivity and activity, as well as, enzyme recycle have been identified as major cost cutting steps to any enzymatic hydrolysis process. In FY 1987 a selection will be made to persue one of the three acid hydrolysis processes currently under study. In FY 1987, research will address the transformation of lignin into octane enhancers and liquid transportation fuels, as well as there use in integrated process schemes to produce liquid fuels in order to use the 20-35 percent of a tree that is lignin.

The focus of the biochemical conversion of biomass to methane rich gases will be to enhance stability and control of anaerobic digesters with dedicated herbaceous crops as the feedstock. This research will enhance the favorability of digester construction and operation, thus eliminating the need for back-up systems and oversizing for safety. For efficiency, the digester must be operated at close to maximum loading rate as possible. Research is needed to determine the biological markers that indicate digester failure, then control systems can be designed that will permit operation at nearly maximum levels. In order to meet the objectives of enhanced stability and control, monoclonal antibodies will be developed for specific organisms in the microbial consortium. These biological markers will allow populations of individual organisms to be monitored before, during, and after digester failure.

Biochemical conversion of municipal solid waste will focus on processes that biologically convert MSW to gaseous fuels. Research will address understanding the life-cycle of microorganisms involved in anaerobic digestion and the modification of these organisms to enhance their productivity. The understanding of the biochemistry and physiology of the ecosystem is essential in the study of methanogenesis for improved digester performance. Research on this cost-shared project will involve methods for injection of refuse derived fuel into the digester, filter care dewatering tests, and optimization of solids content. The private sector is expected to embark on a commercialization of this process pending outcome of the remaining R&D.

FY 1987 funds for capital equipment will be used for analytical equipment and laboratory scale apparatus to support research in biofuels production and conversion. The funds will be equally divided between production and conversion research.

	Adjusted FY 1986 Approp.	FY 1987 Request	Net Change
Wind Energy Systems.............	$24,825,000	$8,250,000	$-16,575,000

The principal objective of the Wind Energy Program is to improve the understanding of fundamental atmospheric processes and their effects on wind turbines and to translate this understanding into tools that the industry can use to design and operate cost-competitive wind turbines. The proposed FY 1987 budget continues the industry/government partnership defined in the recent multi-year plan. The cost, performance and structural lifetime of today's wind turbines must be improved substantially for the industry to be cost-competitive over the long-term. The FY 1987 request for Wind Energy Systems is $8,250,000. This represents a $16,575,000 decrease from the FY 1986 adjusted appropriation of $24,825,000.

The DOE R&D program is structured to assist industry in these developments with two major technical thrusts. The first element is Basic Science of Wind Turbine Dynamics. This thrust includes efforts to understand the random nature of the wind, its complex interaction with the wind turbine rotors, and the effects of this interaction on performance and reliability. The second thrust is Advanced Components and Supporting Research. It is structured to assist industry in identifying promising advanced concepts, such as high performance airfoils.

The FY 1987 request reflects a revised budget structure to implement the above strategy. The majority of the effort included in previous years in the aerodynamics and structural dynamics research elements related to improved understanding of fundamental processes is now in respective subelements in Basic Science of Wind Turbine Dynamics. Similarly, research on advanced airfoils is now proposed under the Advanced Components and Supporting Research element.

Major changes in the request include the completion of vertical axis research in FY 1987 and the phase-out of Mod-5B in FY 1986.

Implementation of research is undertaken through universities, industry, and Federal laboratories, including the consolidated Wind Energy Research Center at Rocky Flats operated by SERI.

BASIC SCIENCE OF WIND TURBINE DYNAMICS

This element is the major technical effort in the DOE wind program and reflects the program structure in the recent multi-year plan. Its subelements are atmospheric fluid dynamics research, aerodynamics research and structural dynamics research, and efforts are focused on improved understanding of how a turbine produces energy.

Atmospheric Fluid Dynamics Research

The need for improved understanding of the local behavior of the wind is demonstrated by experience at windfarms and DOE experimental turbines. In windfarms, many turbines perform poorly, while others experience blade fatigue failure after 2 to 3 months. The major drivers of these operating problems are turbulence induced loads, local (micro-scale) windflow variability and shear, and turbine- to-turbine interaction through the wake of the upwind turbine. These research issues are addressed in this element.

o Microscale Turbulence

Turbulence is a primary driver for fatigue loads experienced by a wind turbine. It is also a very complex phenomenon that varies widely, both spatially and temporally, and is hard to quantify because it is difficult to visualize. Existing models do not satisfactorily represent the stochastic properties of turbulence. DOE research experience and the operational histories of commercial windfarms indicate that turbines with adequate lifetimes cannot be built without a full understanding of turbulence and its influence on aerodynamic lift and structural loads.

Projects proposed will continue rotational sampling research to better represent the wind that a rotating blade encounters and will include basic characterization of the free stream wind input to the turbine, modification of the turbulent wind by the rotor, and improvement to the stochastic wind turbulence models.

- Local Flow and Performance Variability

The performance of individual machines at existing windfarms in complex terrain can vary significantly due to the influence of hills and obstructions at nearby sites. The ability to predict wind speed and direction variations at individual sites would be a great assist to a windfarm developer. Recent progress in verifying a mass-consistent wind flow model with digitized terrain input suggests that this technique is feasible. It would allow turbine installers to avoid siting turbines in locations with especially turbulent or marginal winds. Requested funds would support field validation and theoretical extensions of the models by conducting a multi-site wind measurement program at several locations in mountainous terrain with differing climatic characteristics.

Aerodynamics Research

Understanding the aerodynamic processes that convert the kinetic energy of the wind into mechanical and electrical power is the principal challenge facing the wind energy research community. It is made complicated because the wind input is turbulent, the aerodynamic processes are themselves unsteady and produce turbulence, and radial flow may occur along the blade. Major areas of research include unsteady flow and aeroelastic theories, aerodynamic performance code improvement, and cooperative research with industry. This research is generic in nature and generally independent of turbine size and configuration.

- Unsteady Flow and Aeroelastic Theory

Unsteady aerodynamic effects are believed to be a primary cause of inaccurate prediction of lift and stress in wind turbines and resulting uncertainties in fatigue life and system reliability. In wind tunnel tests on airfoil sections operating with rapidly changing angles of attack representative of turbine operation, dynamic stall has been shown to produce widely varying lift coefficients. The effects of three dimensional flow along the blade are particularly difficult to model or simulate, but are likely to be a significant source of error in predicting stall and performance of intermediate turbines. These factors can not currently be simulated in wind tunnel tests. Requested funding would support advanced wind tunnel testing and refinement of theoretical models.

- Improved Aerodynamic Codes

Existing aerodynamic computer codes are very large, complicated to use, and underpredict cyclic lift and drag forces by as much as a factor of two. Key refinements to reflect dynamic stall, turbulence and three dimensional flow are needed. Requested funding would provide for upgrading computer codes, and simplification where possible, using theoretical extensions developed in the previous subelement.

- Cooperative Research with Wind Turbine Manufacturers and Windfarm Developers

Cooperative research with industry is a key element of the Federal Wind Program. A large body of research data is potentially available from the 8000 or more wind turbines installed in windfarms by the end of 1985. Building on approximately 5 projects started in late 1985, and 5-10 in FY 1986, this subelement permits improvement and validation of aerodynamic and structural theories developed over many years and expedites information exchange between government and industry. These projects are awarded competitively, with maximum industry cost-sharing and minimal Federal paperwork. Tests will be conducted using specially instrumented commercial machines to obtain actual operating data collected in a wide range of environments. This "real world" information will be used to improve understanding of turbulence, aerodynamic performance, wakes and micro-siting, and supporting research.

Structural Dynamics Research

The objective of the structural dynamics research element is to improve understanding of how aerodynamic loads induce structural stresses and resulting fatigue, and, to develop and validate computer codes to permit industry to design wind turbines with a 20 to 30 year life. Current machines have been shown to develop blade problems in less than 3 years, far short of their design life. The reasons for this are not well understood.

Structural design of a wind turbine, given the severe operating environment, particularly with respect to fatigue, is a very difficult task. It requires understanding of the wind as a forcing function, aerodynamic and electric power system processes acting on the structure and how the structure responds. Sources of deterministic loads, i.e. gravity, centrifugal forces, average wind, and start-up/shut-down cycles, are reasonably well understood and modeled satisfactorily. However, loads generated by turbulence and unsteady aerodynamic processes are not well understood and are a key uncertainty. Methods of predicting ultra-high cycle fatigue lifetime for wind turbines are limited in capability and confidence levels.

o Frequency and Time Domain Models

Improvement of structural models to reflect the wind turbulence input, time varying aerodynamic loads, and variable rotor speed operation is essential to the design of cost-effective systems. Modeling interactions among the principal turbine components--blades, rotor, drive trains, and tower--and their interactions with the wind and the electric utility system is the principal role of structural dynamics. This activity becomes more difficult as turbine configurations are revised to get "softer" to reduce loads. Frequency domain models are used to predict natural resonant frequencies and to tune the operating profile to avoid frequencies that are not well damped.Time domain models are more complicated, but are needed to represent the wind as a forcing function and the utility system as a host. Requested funding will provide for analysis of structural data from the cooperative research program. A major thrust is incorporation of turbulence and unsteady aerodynamics into models to improve predictions of stress and fatigue.

o Load Phasing and Fatigue Prediction

Fatigue life projections for wind turbines are subject to gross errors because current understanding of turbulence-induced loads is poor. While progress in rotationally sampled wind research has shown that turbulence on a scale of one blade chord length, rather than a rotor diameter, is significant, there is little understanding of the correlation of turbulence induced loads along a blade. This lack of information applies to both vertical and horizontal axis systems and is needed to improve structural loads models. Funding is requested to support pressure distribution and hot film anemometer testing on experimental and commercial horizontal axis turbines to provide data for improvements in models. Methods of fatigue prediction will also be compared.

ADVANCED COMPONENTS AND SUPPORTING RESEARCH

Advanced components and supporting research involves activities in two areas: advanced subsystems (e.g. airfoil, generators and control systems) and supporting research such as aeroacoustics, utility impacts and program planning.

In the advanced components area, efforts are focused on generic, proof-of-concept activities that make use of Federal research results, the most important of which is advanced airfoils. Most of the existing data on airfoils are on planforms that are intended for aircraft wing, propeller or helicopter rotor applications. Most of these designs are ineffective on wind turbines. This research effort will attempt to fill that gap. Similarly, the supporting research subelement cuts across turbine and disciplinary lines in providing program planning, environment impact studies, analysis of electrical problems associated with operating wind turbines in existing power grid systems, and other research which relates to generic applications of wind systems.

o Advanced Airfoils

Virtually all wind turbines to date have used aviation-oriented airfoils designed for a much more limited range of angles of attack and higher Reynolds numbers than characteristic of wind turbine operation. Recent wind tunnel results indicate that a 20-50 percent improvement in performance and desirable structural characteristics are possible by designing airfoils specifically for the wind turbine environment. Requested funding would continue development of families of horizontal and vertical axis wind turbine airfoils.

o Variable Speed Generation

The potential benefits of variable rotor speed operation are improved energy capture, reduced cyclic stresses, and improved control that offer significant improvement in wind turbine operation. Variable speed operation is considerably more complex than fixed rotor speed operation and industry lacks the necessary design tools at present. The DOE program is structured to develop this information to allow industry to evaluate alternative concepts. Requested funding will continue laboratory and field tests of various variable speed concepts.

o Supporting Research

The supporting research subelement includes planning and assessments, technology transfer activities, windfarm power quality, wind/diesel hybrid research and environmental studies on TVI and noise. Results from the general research program are applied in development of International Energy Agency Recommended Practices and in support of industry standards. Requested funding supports these private sector efforts and provides for systems and economic analyses, workshops and seminars, Historically Black College and Universities (HBCU) research activities and preparation of a wind turbine design handbook.

CAPITAL EQUIPMENT

The FY 1987 request for capital equipment of $170,000 will be used for research test equipment and data acquisition systems at selected laboratories.

	Adjusted FY 1986 Approp.	FY 1987 Request	Net Change
Ocean Energy Systems	$4,811,000	$2,500,000	$-2,311,000

The oceans, covering 71 percent of the earth's surface, collect and store massive amounts of solar energy. Ocean Thermal Energy Conversion (OTEC) is a form of ocean energy which is renewable, capable of furnishing tens of quads per year, and available 24 hours a day, all year long. OTEC also has the potential to produce a variety of energy intensive by-products such as mariculture, fresh water and air conditioning while simultaneously producing energy. Wave energy, although not viewed as being as promising as OTEC in resource potential or availability, is attractive for its potential application to some geographical areas which do not have an OTEC resource. The FY 1987 budget request for Ocean Energy Systems is $2,500,000. This represents a decrease of $2,311,000 from the FY 1986 adjusted appropriation of $4,811,000.

The objective of the ocean energy program is to develop a generic technical data base and reduce the technical risks associated with the extraction and use of ocean derived energy sources to the point that allows industry to judge where and when the technology could be commercialized. DOE's strategy is to perform the necessary R&D required to develop a generic set of experimentally verified predictive models for industry's use. This approach is anticipated to furnish industry with a sufficiently credible data base and incentive to commericalize the ocean technologies, while making additional options available to decision makers in their formulation of a balanced energy supply.

Program emphasis in FY 1987 will be directed toward the "Experimental Verification and Testing" and "Thermodynamic Research and Analysis" segments of the FY 1986 effort. "Material and Structures Research" and "Oceanographic, Environmental and Geotechnical Research" studies have provided a data base available for implementation as integrated efforts within the two areas that are being carried forward and currently do not require the degree of emphasis that was necessary in past years.

EXPERIMENTAL VERTIFICATION AND TESTING

The objective of this program element is to provide a facility for private industry to conduct small-scale seawater tests and experiments which verify OTEC component functional feasibility, performance, and operational characteristics on a scale which can be extrapolated for use in modular systems applicable to small plants.

The FY 1987 budget will provide funds to upgrade the Seacoast Test Facility (SCTF) by expanding the capacity of its seawater systems. This upgrade was specified in the 1985 appropriation bill and is required to allow adequate access to the necessary quantities of warm and cold seawater resources needed to conduct the open-cycle OTEC research experiments. These experiments were also specified by previous appropriation bills, and include validation of components, subsystems and, eventually, a 150 kWe open-cycle test.

The following activity will be supported in FY 1987:

- Seacoast Test Facility Seawater Systems Upgrade
    - The objective of this activity is to provide adequate physical capability at the SCTF to support projected experimental research. This will be accomplished through an on-going 4-year effort to plan, fabricate and install a 30-inch diameter cold water pipe and necessary warm water and discharge pipes to upgrade the SCTF seawater systems. The final design of the installation was completed and long-lead items were procured in FY 1986. Installation of the associated on-shore systems will begin in FY 1987, with completion of the seawater pipe deployment and installation anticipated in FY 1988.

THERMODYNAMIC RESEARCH AND ANALYSIS

The objective of this program element is to experimentally determine the seawater and non-condensible gas effects on the open-cycle heat and mass transfer processes and to validate selected power system analytical models at a scale sufficient to extrapolate to small OTEC plant sizes. This research attempts to establish a generic understanding of how to design potentially cost effective open and latent-heat power systems which could meet the cost goals of the multi-year plan. Reaching these goals is dependent upon increasing the output of the power system and significantly reducing the life cycle cost. Cost reduction for small OTEC plants in the 5 to 15 MWe range is viewed as critical to motivating industrial investment for commericalization of the OTEC technology.

The following activities will be supported in FY 1987:

- Heat and Mass Transfer Analysis and Model Validation

  - This task involves the validation of analytical models for open-cycle OTEC evaporation, condensation and seawater/air sorption processes. During FY 1987, the results from FY 1986 heat and mass transfer experiments will be evaluated. Freshwater laboratory experiments to identify transfer coefficients will be completed and these results will be correlated to seawater engineering data. Process coupling between heat and mass transfer and thermal conversion systems will be modeled and analyzed in this activity. The planning and coordination of the open-cycle program will be accomplished within this activity.

- Advanced Theory for Open-Cycle OTEC Systems Process Integration

  - The objective of this activity is the development of thermodynamic and economic models for open-cycle OTEC systems. In FY 1987, results from fresh water heat and mass transfer experiments conducted in FY 1986 will be incorporated into the open-cycle System Analysis Language Translater (SALT) model to improve the cost algorithms. This task will provide the basis for refining follow-on experiments being performed in FY 1987. The completed product will be an experimentally verified computer model to be used by industry to conduct technology assessments.

	Adjusted FY 1986 Approp.	FY 1987 Request	Net Change
International Solar Energy Program.....	$962,000	$500,000	$462,000

The FY 1987 budget request for Solar International is $500,000, which is a $462,000 reduction from the FY 1986 adjusted appropriation of $962,000.

The Renewable Energy Industry Development Act (P.L. 98-370) passed in 1984 requires that the Federal Government play a catalytic role in promoting U.S. developed renewable energy technology within the competitive international marketplace. The DOE chairs the Committee on Renewable Energy Commerce and Trade (CORECT) and the Renewable Energy program has the lead role for the technical competitiveness subcommittee of this inter-agency working group. Funds will be used to prepare necessary reports and information for use by Federal organizations and industry.

Additionally, budgeted funds are used to conduct a program managed by the trade experts in the Department of Commerce-International Trade Administration (ITA), with broad managerial and technical assistance provided by DOE and the Renewable Energy Export Council, a coordinating body for private sector participants. This Commerce agency cost-shares with U.S. firms the development and presentation of exhibitions, special trade missions, trade seminars and video catalog shows. The FY 1987 funding will provide for a DOE-ITA international trade promotion program with a continuing focus on the international markets of more significant potential.

	Adjusted FY 1986 Approp.	FY 1987 Request	Net Change
Solar Technology Transfer............	$2,938,000	$1,950,000	$1,033,000

The FY 1987 Solar Technology Transfer budget request of $1,950,000 represents a $983,000 reduction from the FY 1986 adjusted appropriation of $2,938,000.

The objective of the program is to continue mainline technical and public informtion services in a low-visibility reactive mode of operations. New funds are requested for the purchase of computer capital equipment for word processing in order to facilitate improved production efficiencies.

	Adjusted FY 1986 Approp.	FY 1987 Request	Net Change
Solar Energy Research Institute......	$2,244,000	$545,000	$1,699,000

General Plant Projects - A total of $230,000 is being requested for general purpose capital improvements to the permanent DOE facilities at the Solar Energy Research Institute (SERI). The improvements proposed are the fabrication of a chemical waste neutralization and/or recycling facility, a combustible gas handling system, and general repairs such as repair and maintenance of tertiary roads, plus fire safety improvements.

General Purpose Equipment - A total of $315,000 is being requested for general purpose equipment for the permanent DOE facilities at SERI. Funds are to be used to improve the efficiency and use of the facility. The actions consist of procuring a remote job entry (RJE) station with tape drive, an IBM 3031 upgrade, a high-speed printer, expansion of the toxic gas monitoring system, a HNU photoionizer with three probes, an upgrade of the radio communications system, and an explosion-proof forklift.

	Adjusted FY 1986 Approp.	FY 1987 Request	Net Change
Solar Program Support...............	$1,251,000	$897,000	$354,000

The FY 1987 budget request for Solar Program Support is $897,000, which is a $354,000 reduction from the FY 1986 adjusted appropriation of $1,251,000.

The purpose of this budget item is to provide cross-technology analytical and administrative support to the overall solar/renewable energy research effort.

Technical and administrative assistance is required to minimize requirements for permanent FTE's and to perform short term analyses more suited to contracted analysis. Fixed operating charges for computer and telecommunication equipment usage will also be funded to promote management efficiencies.

	Adjusted FY 1986 Approp.	FY 1987 Request	Net Change
Solar Resource Assessment............	$962,000	$700,000	$262,000

The FY 1987 budget request for Solar Resource Assessment is $700,000, which is a $262,000 reduction from the FY 1986 adjusted appropriation.

The variability of the solar resource within regions requires greater definition in order to provide the basis for understanding the complex interactions involved in solar technology efficiency and reliability. Activities to improve the overall understanding of resource variability will be continued in order to provide scientific and technical data to researchers and industry participants.

Information regarding the distribution, spectral and temporal variability of solar energy resources is critical for designing appropriate experiments, and for interpolating laboratory and field results. In some instances, the knowledge base appears to be limited and inadequate to postulate and evaluate advanced theories.

For FY 1987, activities will continue for resource measurement and modelling, algorithm development, and the research of new methodoloiges. Projects will continue to be jointly selected by DOE Solar Energy managers, and representatives from other Federal agencies, universities and industry.

	Adjusted FY 1986 Approp.	FY 1987 Request	Net Change
Solar Program Direction...........	$4,516,000	$4,100,000	$416,000

The FY 1987 budget request for Solar Energy Program Direction of $4,100,000 will support a full-time equivalent (FTE) staffing level of 70. This proposal is a $416,000 reduction from the FY 1986 adjusted appropriation and a reduction of 18 FTEs.

The Federal Solar Energy staff activities consist of three major functions; project/task management, R&D coordination/technology transfer, program and general administration duties. A wide variety of professional and clerical skills are necessary to administer R&D relating to several innovative technologies, and cross-cutting functional activities.

DEPARTMENT OF ENERGY

FY 1987 CONGRESSIONAL BUDGET REQUEST

PROGRAM OVERVIEW

GEOTHERMAL

The Geothermal Energy Program continues to play a major role in building a technology base to enable the private sector to economically develop the various forms of geothermal resources. Through this effort the Geothermal Program provides an array of technology options that expand and strengthen the energy supply mix from which industry can draw in developing products and processes for commercial applications.

Accordingly, the program places an increased emphasis on R&D activities which are cost-shared with the private sector and that provide the appropriate stimulus and support for development. These activities primarily focus on basic and applied research, technology development, technical assistance and information activities. By employing strategies which couple federally funded basic and applied research and development efforts with timely technology transfer, security and flexibility in the energy marketplace is enhanced.

In addition, a new innovative approach to cooperative R&D ventures with the private sector will be closely examined. Through appropriate dialogue with industry, the framework for joint partnership between Government and industry cooperative ventures, which will effectively broaden research support and technology transfer, can be established and if successful will significantly lower the Federal expenditures.

Prior Year Accomplishments:

- Developed new geophysical survey methods and equipment for the acquisition and field analysis of seismic and electromagnetic signals from the earth. The geothermal industry has adopted these methods as standards. Development of 2- and 3-dimensional methods for interpretation of geophysical data have had an immediate impact on industry exploration.
- Research in geothermal brine injection has shown that chemical and physical changes to the reservoir caused by production can be predicted, and through injection management, reservoir problems can be avoided. Initiated development of fluorocarbons for tracer usage; completed analysis of drift phenomena in injection backflow data; initiated experimental testing of conventional tracers and initiated modeling and field testing of borehole resistivity. Industry is using the products of this research to lengthen the useful life of geothermal fields.
- Initiated activities to develop an advanced drill bit using a hybrid system wit polycrystalline diamond cutters and water jets; completed electrical design of improved acoustic borehole televiewer; and laboratory tested DOE/industry cooperative drilling equipment.
- Completed laboratory studies on pitting-resistant steel used as cladding for well casings; and tested advanced materials and instruments in the laboratory and field.

- Initiated leaching tests to determine technical feasibility of waste encapsulation while meeting environmental regulations; initiated experiments to determine technical feasibility for decontaminating waste fluids from heavy metals using biochemical methods on geothermal waste.

- Completed isobutane supercritical cycle thermal loop tests; completed vertical-condenser thermal and power-loop testing with isobutane-hexane mixtures as working fluids. This greatly expanded the temperature range over which binary geothermal plants could operate.

- Operated the Geothermal Test Facility in support of heat-cycle research, and performed tests of industry material and equipment.

- Drilled the Salton Sea scientific borehole in a hot hydrothermal reservoir near a magma body and initiated engineering evaluations and resource studies related to the deep scientific hole to test the premise that geothermal resources are larger than presently estimated; studied thermal gradient and other geophysical measures to develop techniques for evaluating geothermal resources masked by deep-flowing rainwater.

- Completed preliminary analysis of magma energy conversion concepts and systems economics, performed seismic survey for probable magma chamber, and tested selected materials for compatibility with magma environment.

- Synchronized, in June, 1985 the main power turbine-generator of the Heber Binary Power Plant (i.e., made compatible with the frequency requirements of the transmission system), following initial turbine tests. After careful shakedown experiments, the complete power plant continued partial power tests in 1986.

- Flow testing at high rates resulted in scale accumulation in a geopressured production well. Chemicals were injected into the producing formation in a test of a new scale control technique. Subsequently, the well was flowed at high rates for extended periods of time without scaling.

- As the result of redrilling one of the two Hot Dry Rock wells, successfully connected the large fracture zone produced from the lower well in 1985 to form a below-ground heat transfer circuit. Initial heat removal experiments were carried out while equipment was designed and constructed for extended heat removal experiments during FY 1986; in addition, the below-ground flow pattern was modified to improve the system hydrodynamics.

DEPARTMENT OF ENERGY
FY 1987 CONGRESSIONAL BUDGET REQUEST
LEAD TABLE
GEOTHERMAL
ENERGY SUPPLY RESEARCH AND DEVELOPMENT

(Tabular dollars in thousands. Narrative material in whole dollars)

	FY 1985 Appropriation	FY 1986 Adjusted Appropriation	FY 1987 Base	FY 1987 Request	Request vs Base
Geothermal Energy					
Operating Expenses	$29,298	$26,200	$26,200	$17,930	-$ 8,270
Capital Equipment	$ 400	$ 481	$ 481	$ 0	-$ 481
	$29,698	$26,681	$26,681	$17,930	-$ 8,751
Staffing					
Total FTE	12	15	15	12	(3)

Authorization: P.L. 93-410 Geothermal Energy Research, Development and Demonstration Act of 1974.

Department of Energy

FY 1987 Congressional Budget Request

Adjustments to FY 1986 Appropriations

Geothermal (CE)	FY 1986 Conference	General Reduction	Management Initiatives	Pay Cost Restoration	General Reduction	Gramm-Rudman-Hollings Reduction	Subtotal	Comparability Adjustments	Adj. Approp. Total
Hydrothermal Industrialization Operating Expenses	$ 2,000	$ ---	$ -400	$ -203	$ ---	$ -75	$ 1,322	$ 203	$ 1,525
Geopressured Resources Operating Expenses	4,600	---	---	-5	---	-174	4,421	5	4,426
Geothermal Technology Development Hot Dry Rock Research	5,500	---	---	---	---	-752	4,748	---	4,748
Hydrothermal Research									
Operating Expenses	$ 8,000	$ ---	$ ---	$ -1	$ ---	$ ---	$ 7,999	$ 1	$ 8,000
Capital Equipment	200	---	---	---	---	-8	192	---	192
Subtotal	$ 8,200	$ ---	$ ---	$ -1	$ ---	$ -8	$ 8,191	$ 1	$ 8,192
Hard Rock Penetration Research									
Operating Expenses	$ 2,400	$ ---	$ ---	$ ---	$ ---	$ ---	$ 2,400	$ ---	$ 2,400
Capital Equipment	200	---	---	---	---	-8	192	---	192
Subtotal	$ 2,600	$ ---	$ ---	$ ---	$ ---	$ -8	$ 2,592	$ ---	$ 2,592
Magma Energy Extraction Research									
Operating Expenses	$ 4,400	$ ---	$ ---	$ ---	$ ---	$ ---	$ 4,400	$ ---	$ 4,400
Capital Equipment	100	---	---	---	---	-3	97	---	97
Subtotal	$ 4,500	$ ---	$ ---	$ ---	$ ---	$ -3	$ 4,497	$ ---	$ 4,497
Total, Geothermal Technology Development	$27,400	$ ---	$ -400	$ -209	$ ---	$-1,020	$25,771	$ 209	$25,980
Program Direction	800	-56	---	-70	-14	-29	631	70	701
Subtotal, Geothermal	$28,200	$ -56	$ -400	$ -279	$ -14	$-1,049	$26,402	$ 279	$26,681
General Reduction: Operating Expenses	-56	56	---	---	---	---	---	---	---
Management Initiatives: Operating Expenses	-400	---	400	---	---	---	---	---	---
F.E Reduction	-14	---	---	---	14	---	---	---	---
Pay Restoration	-279	---	---	279	---	---	---	---	---
Use of Prior Year Balances (Geothermal) Operating Expenses	279	---	---	---	---	---	279	-279	
Total, Geothermal	$27,730	$ ---	$ ---	$ ---	$ ---	$-1,049	$26,681	$ ---	$26,681
Operating Expenses	$27,230	$ ---	$ ---	$ ---	$ ---	$-1,030	$26,200	$ ---	$26,200
Capital Equipment	500	---	---	---	---	-19	481	---	481

DEPARTMENT OF ENERGY
FY 1987 CONGRESSIONAL BUDGET REQUEST
SUMMARY OF CHANGES

GEOTHERMAL

(Dollars in Thousands)

FY 1986 Appropriation adjusted	$26,681
Program increases and decreases:	
o Geothermal R&D Operating Expenses	-$ 8,270
o Capital Equipment	-$ 481
FY 1987 Budget Request	$17,930

DEPARTMENT OF ENERGY
FY 1987 CONGRESSIONAL BUDGET REQUEST
GEOTHERMAL ENERGY NARRATIVE

	FY 1986 Adjusted Approp.	FY 1987 Request	Net Change
Geothermal	$26,681,000	$17,930,000	-$8,751,000

The objective of the Geothermal R&D program is to sponsor research which will facilitate the expanded use by industry of the large, underutilized resource represented by the various forms of geothermal energy. Cooperation with industry is vital to an effective program, and on-going efforts such as cost-shared electricity generation experiments with geopressured resources will be expanded. The program includes research on hydrothermal reservoirs, energy conversion technology, improved hard rock penetration technologies, and advanced technology for the extraction of energy from geopressured, hot dry rock, and magma geothermal resources. Also included is funding for program direction, to manage a broad range of geothermal research and development. The FY 1987 Departmental Request for Geothermal is $17,930,000, which is a $8,751,000 reduction from the FY 1986 adjusted appropriation of $26,681,000.

	FY 1986 Adjusted Approp.	FY 1987 Request	Net Change
Hydrothermal Industrialization	$ 1,525,000	$ 0	-$ 1,525,000

No funds are being requested in FY 1987. The assessment of hydrothermal energy resources on a state basis has progressed to a stage where individual states have the capability to continue these activities as required.

	FY 1986 Adjusted Approp.	FY 1987 Request	Net Change
Geopressured Resources	$ 4,426,000	$ 3,000,000	-$ 1,426,000

The objective of the geopressured resource program is to define the extent and energy content of the geopressured resource and to determine significant technical parameters for extracting and using chemical, thermal, and mechanical energies contained in the geopressured brines. Geopressured brine and natural gas occur worldwide, but are especially well documented beneath the U.S. Gulf of Mexico coast, where the U.S. Geological Survey (U.S.G.S) estimates there are over 60,000 Quads of thermal energy and 50,000 Quads of dissolved methane in place. Prior research under this program has established the magnitude of the resource base, and has shown that the brine can be produced, the methane recovered, and the spent brine injected. But the capacity for extended production at high flow rates has not yet been established. In addition there are the problems related to scaling in wells and the possibility of land subsidence. The proposed research in FY 1987 will address the uncertainties in reservoir longevity and provide technical data that industry can exploit to determine the role of this vast domestic resource in future energy markets.

FY 1987 funds will be used to conduct experimental production testing of wells especially designed and drilled for this research. The wells produce hot brine that contains dissolved natural gas. High pressure in the underground reservoirs causes the brine to flow freely, without pumping, through wells. These multi-year tests, at flow rates in the millions of gallons per day range, will reveal the dynamic characteristics of the underground reservoirs of brine and gas. At the wellhead, natural gas is readily separated from the brine. In cooperation with industry, tests are being conducted on systems that convert the thermal and chemical energy content of the brine to electric power. Scaling control methods, developed in cooperation with industry, also will be tested.

Supporting research will include: chemical analysis of the produced brines and hydrocarbons; analysis of brine pressure, temperature and flow rates to infer underground reservoir rock conditions; scale control research; and investigation of environmental effects, especially land subsidence.

	FY 1986 Adjusted Approp.	FY 1987 Request	Net Change
Geothermal Technology Development....................	$20,029,000	$14,150,000	-$5,879,000

There are four geothermal technology development activities included under the Departmental Request: hydrothermal research, hard rock penetration research, magma energy extraction research, and hot dry rock research.

- Hydrothermal Research

  The objective of this activity is to perform research on geothermal reservoirs and energy conversion systems in order to expand the hydrothermal resource base available for development by the private sector. Additional emphasis will be directed toward research on second generation binary systems that will make possible utilization of widespread moderate temperature hydrothermal resources. Royalties from power generated on Federal land already exceed the funding level for DOE hydrothermal research, and these Government revenues are expected to increase greatly as the advancing technology base provides industry with the opportunity to exploit more of the resource. New methodology is being developed to locate and penetrate fractures, the main permeable channels for fluid flow in the reservoir. Instruments and materials will enable industry to evaluate the resource and to produce the energy with the least delay. Large gains in conversion efficiency are obtainable if reliability can be improved. New methods for locating and evaluating the potential resource in selected areas are being tested for applications to this and similar systems.

  FY 1987 research will be conducted in the following areas: reservoir definition technology, brine injection technology, materials research, advanced brine chemistry, heat cycle research, Geothermal Test Facility operations, Salton Sea and Continental Scientific Drilling Projects, and Caldera reservoir investigations.

  - Reservoir Definition Technology: The objective of this task is to improve the technologies needed to locate, delineate, characterize, and control hydrothermal reservoirs. An improved understanding of geothermal reservoirs will allow private industry to efficiently utilize this energy resource. This task will cover that part of the research which is generic and cannot be accomplished solely by the geothermal industry. Joint research projects with industry participation will be used to advance the technology.

FY 1987 funds will be applied to reservoir studies to determine the location and extent of fractures, the physical and chemical properties of fluid flow, and the most efficient methods of production from the reservoir. Models will be developed and tested with field data to correlate the actual data with model predictions.

- Brine Injection Technology: The objective of this task is development of technology for the economic injection of spent brines into geothermal reservoir formations in order to recharge the reservoir, dispose of the brine, and minimize subsidence. Previous research has shown that injection is necessary to obtain the optimum energy production and longevity from geothermal reservoirs. Several parameters such as location of production and injection wells, flow rates of the wells, and chemistry of injected brine can be adjusted to provide the maximum energy recovery. This task will conduct the research necessary to understand the control of these parameters.

  FY 1987 funds will be used to conduct cost-shared field studies and analysis involving interference pressure tests and tracer test in order to determine the best methodology for location and operation of injection wells; to develop predictive methods for anticipating pressure, chemical, and thermal pulses from injection to production wells; and to develop methods for establishing the rate of chemical precipitation around injection wells.

- Materials Research: The objective of this task is the development of geothermal systems that are capable of resisting highly hostile geothermal environments for prolonged periods of time, thereby increasing equipment life and reliability and reducing the cost of fluid handling. Cost-sharing with industry will continue in this area.

  FY 1987 funds will be used to perform research on metal liners for well casing, polymer concrete composites for heat exchanger tubing, and high temperature cements.

- Advanced Brine Chemistry: The objective of this task is to provide the research necessary to evaluate advanced processing technology for safe disposition of hypersaline geothermal brines. Previous research has shown that geothermal brines contain significant quantities of several metals. These metals represent hazardous waste that must be disposed of, thus increasing the cost of geothermal operations.

  FY 1987 funds will be used to investigate extraction processes that can be used with geothermal brines and solid residues to reduce the hazard of geothermal wastes. In addition, technology will be developed to measure key chemical constituents in process and energy conversion systems.

- Heat Cycle Research: The objective of this task is the development of technology for the economic generation of electricity from moderate temperature hydrothermal resources. These resources are four times as numerous as the high-temperature resources which are currently exploitable with first generation energy conversion technology. If the moderate temperature reservoirs are to be utilized, a new generation of more efficient, reliable, and less costly binary technology must be developed.

  FY 1987 funds will be used to test supersaturated hydrocarbon turbine expansions and to investigate methods of improving direct contact heat exchangers for high salinity brines in order to increase the efficiency of the conversion of geothermal energy.

- Geothermal Test Facility: The objective of the test facility is to provide a field site for testing of geothermal energy conversion systems of interest to industry, in an actual geothermal environment.

  FY 1987 funds will be used to operate the DOE Geothermal Test Facility which will be used for industry and DOE field testing activities. The facility contains geothermal wells and brine handling equipment, test pads, workshops, offices, and a chemistry laboratory.

- Salton Sea Scientific Drilling Project: The objective of this research is to determine the nature of potential reservoirs that underlie a known high-temperature hydrothermal reservoir, in order to better understand the genesis and structure of hydrothermal resources and to assess theories that the nation's hydrothermal resources are far larger than previously estimated. Further, this task will provide the technology and the new and improved materials, tools, equipment, and instrumentation that will be required to conduct drilling, testing, measuring and sampling operations in the hostile environments expected to be encountered in continued scientific drilling into deep thermal regimes. This project is an integral part of the Federal Continental Scientific Drilling Program coordinated between DOE, USGS and NSF. Results of this task when combined with the larger effort of the other agencies, increases the benefit to the geothermal energy program by a very large factor.

  The FY 1987 funds will be used to conduct resource studies, and synthesize results of all the engineering and chemical analysis and instrument testing related to the scientific drilling, testing, and measuring in deep, hot reservoirs containing highly corrosive but potentially valuable brines.

  The funds will also be used to develop, in cooperation with industry, new drilling and casing systems and downhole materials, instruments and sampling techniques.

- Caldera Reservoir Investigations: The objective of this task is to conduct research on techniques for investigating the nature of hydrothermal reservoirs associated with young andesite volcanoes. In such areas the geothermal reservoirs are masked by shallower, cooler aquifers and lower vertical permeability so that thermal gradient measurements and other scientific measurements only begin to characterize the reservoirs at greater depths. Geophysical measurements combined with wells designed for maximum scientific return will be used to perform this research.

  FY 1987 funds will be used to analyze and interpret the drilling, geophysics and geology results gained from prior year testing and measuring of several deep thermal gradient research boreholes. The boreholes were developed to carry out research and tests of new system sensing and evaluation techniques to study young volcanic fields. The project is being cost-shared with industry under cooperative agreements.

o Hard Rock Penetration Research

Geothermal wells represent forty to sixty percent of the cost of geothermal electric power and an even larger fraction of the cost of many direct heat applications. Although geothermal wells are drilled and completed using technology adapted and evolved from oil and gas well drilling, the hot, hard crystalline rock and corrosive environment cause such a rapid degradation of the drilling equipment that geothermal well costs are considerably higher than the costs of similar oil and gas wells by a factor of two to four.

The purpose of research under this activity is to increase the portion of the geothermal resource which is currently exploitable by reducing the technological risks associated with drilling and completing geothermal wells; by investigating new concepts, in cooperation with industry, that show promise for incorporation into second generation geothermal drilling systems; and by performing research in promising technical areas such as advanced alloys, new physical processes, and new design concepts.

In FY 1987, research tasks will be conducted in the following areas:

- Advanced Drilling Research: The objective of this task is to evaluate selected advanced candidate methods for breaking and removal of rock, which have the potential for development into advanced drilling systems.

  FY 1987 funds will be used to perform research, jointly with industry, on several revolutionary drilling concepts. These will include a hybrid drill bit with high pressure jet-assisted cutters; a thruster/retractor for applying weight-on-bit when drilling with downhole motors; downhole measurement, data processing, and control while drilling; and spoolable drill pipe.

- Mechanics of Rock Penetration: The objective of this task is to analyze cavitating jets and drill string dynamics and to measure the parameters associated with rock penetration by methods such as crushing, spalling, shearing, erosion and shock loading under simulated geothermal downwell conditions.

  In FY 1987, the interaction between geothermal formation and drill bit cutters will be studied in laboratory experiments and computer simulations to determine and characterize the critical formation and drilling system properties which control the process of rock penetration. The studies will include rock mechanics as well as the behavior of drill bit cutters, and the influence of various types of drilling fluids.

- Drilling Fluid Loss Control: The objective of this task is to develop new effective materials for controlling the loss of drilling fluids into fractures or aquifers encountered during drilling and completion in high temperature environments. Loss of drilling fluid is one of the most serious problems in geothermal well drilling today since the drilling process must be halted until the situation is corrected; often, the formation can be damaged permanently by excess fluid loss.

  FY 1987 funds will be used to evaluate, in cooperation with industry, new fluid loss materials for preventing and controlling lost circulation in geothermal wells, and to develop computer models to understand the flow near a lost circulation zone to permit the design of remedial methods which correctly address the problem.

o Magma Energy Extraction

The objective of this activity is to understand and evaluate the energy potential contained in the magma resources of the United States. Through this research effort, the knowledge necessary to use this potentially large energy source will be gained. New materials are being developed to withstand the high-temperature (1000°C) corrosive magma environment, and instruments are being designed to monitor drilling and extraction conditions. Incomplete data exists on the depth and size of continental magma chambers. Estimates must be refined based on field and experimental laboratory data, and extrapolations of technology capability must be made and used for an update of the potential of United States magma resources to help supply energy in the future.

The FY 1987 funds will be used to determine the technological potential of magma energy and the advantages of different energy conversion methods and heat extraction processes. Research on materials, equipment, and instrumentation for the high-temperature, hostile environment of magma will continue. In addition, estimates of the depth, size, and temperature of prospective magma chambers will be refined, based on continued data gathering, analysis and interpretation.

o Hot Dry Rock Research

The objective of Hot Dry Rock (HDR) research is to study the fundamental properties of deep hot crystalline rock systems and, based on those findings, determine the technical boundaries and economic feasibility of extracting geothermal heat from hot dry rock resources. The USGS has estimated that in the U.S. as much as 450,000 Quads of potential energy exists in hot dry rock. However, before this vast resource can be expected to be used, it is necessary to develop the science and technology necessary to extract that energy. As part of the Hot Dry Rock project, proof-of-concept experiments were completed in 1980 with a single-fracture thermal loop, and two wells have since been successfully drilled into hot crystalline rock and connected in 1985 through a large reservoir created by a massive hydraulic fracture. Under current plans the loop will be tested to determine system characteristics such as (1) flow control through a multi-fractured system; (2) predicted thermal drawdown and reservoir longevity; (3) reservoir hydrodynamics; (4) changes in system flow impedance; (5) rock-fluid interaction; and (6) environmental effects. It is expected that these tests will be completed by FY 1989. These system characteristics are parameters which must be understood before private sector development can be expected. The preparation and testing of this loop is covered by an International Energy Agency cooperative agreement, and both West Germany and Japan have made important financial and scientific contributions to the project. Their support has been one of the major factors in the experimental progress to date.

FY 1987 funds will be used to complete the assembly and begin the extended testing of a circulation loop and heat exchanger system. This system is a critical part of a reservoir evaluation experiment to determine the characteristics of the large hydraulically-fractured reservoir. Energy capacity studies of the hot crystalline rock containing interconnected flow channels will also be carried out.

Supporting research studies include an evaluation of alternative flow control systems, the use of chemically reactive tracers to map time-temperature flow channels, and the analysis of seismic signals to detect tensile as well as shear fracturing events.

	FY 1986 Adjusted Approp.	FY 1987 Request	Net Change
o Program Direction...............	$ 701,000	$ 780,000	+$ 79,000

The budget request supports 12 FTEs. This includes administrative and technical personnel who manage a broad range of geothermal research and development activities.

Personnel assigned to Headquarters will perform a number of responsibilities including the establishment of broad objectives, determination of work scope, allocation of general resources, and technical management necessary for program direction. Responsibilities will also include the assessment of progress made in meeting DOE technical milestones and cost expenditures, coordination of contractor activities, and initiation of appropriate actions to resolve problems in any of these areas. Further, responsibilities will include administrative and functional activities such as budgeting, procurement, long and short range program planning and personnel management activities. In addition, personnel will be required to interface with a number of other Federal agencies (such as DOD, NASA, NBS, and DOI), national laboratories, industrial concerns, and international bodies in order to execute and coordinate programs of mutual interest.

In addition to activities proposed for funding for FY 1987, research and industrialization projects which were initiated in prior years will be completed during this same period.

DEPARTMENT OF ENERGY
FY 1987 CONGRESSIONAL BUDGET REQUEST
LEAD TABLE
HYDROPOWER
ENERGY SUPPLY RESEARCH AND DEVELOPMENT
(Tabular dollars in thousands. Narrative material in whole dollars)

Hydropower CE	FY 1985 Appropriation	FY 1986 Adjusted Appropriation	FY 1987 Base	FY 1987 Request	Request vs Base
Small-Scale Hydropower Development					
Operating Expenses	$ 375	$ 436	$ 436	$ 0	-$ 43
Capital Equipment	$ 0	$ 0	$ 0	$ 0	$
Subtotal	$ 375	$ 436	$ 436	$ 0	-$ 43
Program Direction					
Operating Expenses	$ 72	$ 45	$ 45	$ 0	-$ 4
Subtotal	$ 72	$ 45	$ 45	$ 0	-$ 4
Total					
Operating Expenses	$ 447	$ 481	$ 481	$ 0	-$ 48
Capital Equipment	$ 0	$ 0	$ 0	$ 0	$
Subtotal	$ 447	$ 481	$ 481	$ 0	-$ 48
Staffing					
Total FTE	1	1	1	1	0

Authorization:
P.L. 93-577 - Non-Nuclear Energy Research & Development Act of 1974, Section 4
P.L. 95-617 - Public Utilities Regulator Policies Act of 1978
P.L. 96-294 - Energy Security Act of 1980

Department of Energy

FY 1987 Congressional Budget Request

Adjustments to FY 1986 Appropriations

Hydropower	FY 1986 Conference	Pay Cost Restoration	Gramm-Rudman-Hollings Reduction	Subtotal	Comparability Adjustments	Adj. Approp. Total
Small-Scale Hydropower Development Operating Expenses	$ 453	$ -3	$ -17	$ 433	$ 3	$ 436
Program Direction Operating Expenses	47	---	-2	45	---	45
Subtotal, Hydropower	$ 500	$ -3	$ -19	$ 478	$ 3	$ 481
Pay Restoration	-3	3	---	---	---	---
Use of Prior Year Balances (Hydropower) Operating Expenses	3	---	---	3	-3	---
Total, Hydropower	$ 500	$ ---	$ -19	$ 481	$ ---	$ 481
Operating Expenses	$ 500	$ ---	$ -19	$ ---	$ ---	$ 481

DEPARTMENT OF ENERGY
FY 1987 CONGRESSIONAL BUDGET REQUEST
HYDROPOWER
SUMMARY OF CHANGES

(Dollars in Thousands)

FY 1986 Appropriation adjusted	$ 481
Program Increases and Decreases:	
o Technology Support	-$ 436
o Reduce Program Direction	-$ 45
FY 1987 Budget Request	$ 0

DEPARTMENT OF ENERGY

FY 1987 CONGRESSIONAL BUDGET REQUEST PROGRAM OVERVIEW

HYDROPOWER

Since 1977 the Department has invested more than $70 million in the Small-Scale Hydropower Program. The program's activities have succeeded in providing a technology base to industry for use in its decision-making process, and it has been determined that development can now be turned over to the private sector. Therefore, no funds are requested for FY 1987.

By the end of 1986, eighteen Technology Development projects will be on-line, with one more (Flat Rock) under construction. By the end of FY 1986, at least one of the three engineering R&D projects will be operational. These will be monitored as necessary on an *ad hoc* basis, and the design, construction and operation and maintenance data transferred to industry.

	FY 1986 Adjusted Approp.	FY 1987 Request	Net Change
Hydropower............................	$ 481,000	$ 0	-$ 481,000

The FY 1987 Departmental Request for hydropower is 0. This represents a decrease of $481,000 from the FY 1986 adjusted appropriation. Remaining projects will be monitored by DOE as necessary on an *ad hoc* basis.

DEPARTMENT OF ENERGY
FY 1987 CONGRESSIONAL BUDGET REQUEST
Electric Energy Systems and Energy Storage

The mission of the Electric Energy Systems and Energy Storage program supports directed research to provide options for future electric network, electrochemical and energy storage systems, and stimulate new concepts and systems to enhance the reliability, efficiency, and safety of the Nation's energy systems under normal and abnormal conditions. The program will attempt to utilize partnerships with industry through cooperative R&D ventures on applied technology development of generic or precompetitive nature.

The Electric Energy Systems (EES) research is in three areas: (1) Electric Field Effects, on biological effects and risks to life forms exposed to high voltage electric and magnetic fields; (2) Reliability, to provide an understanding of the future electric networks to retain the reliability, and National security of the Nation's more complex electrical systems; (3) Systems Technology, to provide the technology base for improved electric power systems by exploring new concepts and developing new materials.

The Energy Storage (STOR) research is in two areas: (1) Electrochemical, to provide the technology base for more efficient, less expensive, safer, and more reliable batteries for electric vehicles, electric utility load leveling, and other stationary energy storage applications; (2) Thermal and Mechanical, to provide the technology base for chemical/ hydrogen production and advanced thermal storage systems through new materials, catalysts, and processes.

DEPARTMENT OF ENERGY
1987 CONGRESSIONAL BUDGET REQUEST
LEAD TABLE
ELECTRIC ENERGY SYSTEMS AND ENERGY STORAGE
ENERGY SUPPLY RESEARCH AND DEVELOPMENT
(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1985 Appropriation	Adjusted FY 1986 Appropriation	FY 1987 Base	FY 1987 Request	Request vs Base
Electric Energy Systems					
Operating Expenses	$19,493	$11,548	$11,548	$7,619	$-3,929
Capital Equipment	224	0	0	0	0
Total	$19,717	$11,548	$11,548	$7,619	$-3,929
Staffing					
Total FTE	7	6	6	5	-1
Energy Storage					
Operating Expenses	18,152	17,100	17,100	8,600	-8,500
Capital Equipment	490	192	192	0	-192
Total	$18,642	$17,292	$17,292	$8,600	$-8,692
Staffing					
Total FTE	6	6	6	6	0

Authorization:	
P.L. 93-409,	Solar Heating and Cooling Demonstration Act of 1974.
P.L. 93-577,	Federal Nonnuclear Energy Research and Development Act of 1974.
P.L. 94-413,	Electric and Hybrid Vehicle Research, Development, and Demonstration Act of 1976.
P.L. 95-91,	Department of Energy Organization Act.
P.L. 95-590,	Solar Photovoltaic Energy Research, Development, and Demonstration Act of 1978.
P.L. 95-619,	National Energy Conservation Policy Act of 1978.

Department of Energy

FY 1987 Congressional Budget Request

Adjustments to FY 1986 Appropriations

	FY 1986 Conference	Pay Cost Restoration	Gramm-Rudman-Hollings Reduction	Subtotal	Comparability Adjustments	Adj. Approp. Total
Electric Energy Systems						
Electric Field Effects Operating Expenses	$ 3,000	$ ---	$ -113	$ 2,887	$ ---	$ 2,887
Reliability Research & Development. Operating Expenses	3,000	-1	-113	2,886	1	2,887
Systems Technology Operating Expenses	5,630	-39	-212	5,379	39	5,418
Program Direction	370	---	-14	356	---	356
Subtotal, Electric Energy Systems	$12,000	$ -40	$ -452	$11,508	$ 40	$11,548
Pay Restoration	-40	40	---	---	---	---
Use of Prior Year Balances (EES) Operating Expenses	40	---	---	40	-40	---
Total, Electric Energy Systems	$12,000	$ ---	$ -452	$11,548	$ ---	$11,548
Operating Expenses	$12,000	$ ---	$ -452	$11,548	$ ---	$11,548

Department of Energy

FY 1987 Congressinal Budget Request

Adjustments to FY 1986 Appropriations

Energy Storage Systems	FY 1986 Conference	Management Initiatives	Pay Cost Restoration	Gramm-Rudman-Hollings Reduction	Subtotal	Comparability Adjustments	Adj. Approp. Total
Battery Storage							
Operating Expenses	$14,500	$ -130	$ -38	$ -542	$13,790	$ 38	$ 13,828
Capital Equipment	200	---	---	-8	192	---	192
Subtotal	$14,700	$ -130	$ -38	$ -550	$13,982	$ 38	$14,020
Thermal and Mechanical Storage Operating Expenses	$ 3,060	$ ---	$ ---	$ -115	$ 2,945	$ ---	$ 2,945
Program Direction	340	---	-2	-13	325	2	327
Subtotal, Energy Storage Systems	$18,100	$ -130	$ -40	$ -678	$17,252	$ +40	$17,292
Management Initiatives: Operating Expenses	-130	130	---	---	---	---	---
Pay Restoration	-40	---	40	---	---	---	---
Use of Prior Year Balances (ESS) Operating Expenses	40	---	---		40	-40	---
Total, Energy Storage Systems.	$17,970	$ ---	$ ---	$ -678	$17,292	$ ---	$17,292
Operating Expenses	$17,770	$ ---	$ ---	$ -670	$17,000	$ ---	$17,100
Capital Equipment	200	---	---	-8	192	---	192

SUMMARY OF CHANGES
(in thousands of dollars)

ELECTRIC ENERGY SYSTEMS

FY 1986 Adjusted Appropriation $11,000

Program Increases and Decreases:

- The Electric Energy Systems research program will be reduced, with some projects closed out and others stretched out.

FY 1987 Request .... $ 7,619

ENERGY STORAGE

FY 1986 Adjusted Appropriation $17,292

Program Increases and Decreases:

- The Energy Storage research program will be reduced, with some projects closed out and others stretched out.

FY 1987 Budget Request .... $ 8,600

The mission of the Electric Energy Systems and Energy Storage program is to support directed research which will provide options for future electric network, electrochemical and energy storage systems, and stimulate development of concepts and systems which will enhance the reliability, efficiency and safety of the Nation's energy systems under both normal and abnormal operating conditions.

The Electric Energy Systems (EES) program supports research directed toward solving mid- to long-term problems in electric transmission and distribution, and integrating new concepts and renewable energy resources into the utility network. The research is divided into three subprograms:

- Electric Field Effects - The objective is to support research on the biological effects and risks to life forms exposed to high voltage electric and magnetic fields.

- Reliability R&D - The objective is to provide an understanding of the future electric networks through research to retain the reliability of the Nation's increasingly larger and more complex electrical transmission and distribution systems for national security and economic health.

- Systems Technology - The objective is to provide the technology base through research on new concepts and materials such as next generation semiconductors which will provide improved components in the future for applications in electric power systems and contribute to overall development of the technology base.

The results of the sponsored R&D will help form the basis for a continuous future supply of energy in the most cost-effective and safe manner possible while meeting National security and human safety goals. The commitment to research required to develop and maintain safe and reliable advanced energy storage and distribution systems is longer and more sustained than any group of utilities, or research arm of industry has thus far made.

The Energy Storage (STOR) Program supports research of advanced energy storage and electrochemical systems that will facilitate the substitution of oil and gas fuels by coal, nuclear and renewable energy sources, and will increase the reliability and efficiency of the energy economy. The research is divided into two subprograms:

- Electrochemical - The objective is to provide the technology base for more efficient, less expensive, safer and more reliable rechargeable batteries and other electrochemical systems for use in electric vehicles, electric utility load leveling and other stationary energy storage applications.

- Thermal and Mechanical - The objective is to provide the technology base for chemical/hydrogen production and advanced thermal storage systems for use in residential, commercial, industrial and utility applications. The focus of activities in this area is to investigate new materials, catalysts, and processes to meet performance requirements for thermal storage and hydrogen as a cost-effective energy carrier and potential storage medium.

Recent accomplishments of the Electric Energy Systems research program include:

- Completed Purdue University Power Systems Simulator. This simulator is being used by the government and private sector as a research tool to develop dynamic analysis of systems/generators during system disturbances.
- Completed test protocols for 2 Megawatt (MW) zinc/chlorine battery at the BEST facility.

- Completed life testing of the 1200 kV compressed gas insulated transmission underground cable and substation equipment at EPRI's Waltz Mill Facility. With the successful completion of the life test, the 1200kV compressed gas insulated cable and substation equipment technology will be transferred to the utility industry.

- Completed development of High-Voltage Direct Current (HVDC) compressed gas insulated cable technology and transferred technology to cable industry.
- Completed research identifying safety and protection requirements for small power producers connected to distribution system. This will allow the integration of diversified power sources without compromising the integrity of the electric network.
- Completed project to develop advanced concepts for superconducting synchronous generator.
- Completed investigation of harmonic frequency propagation from dispersed generating devices in distribution networks and on the impact of harmonics on selected protective devices not only on the electric network but also on the owner's equipment.
- Completed assessment of fiber optics technology applications for power systems sensing and communication. This technology shows promise for greatly enhanced real-time systems operations and control.
- Completed circadian (daily) rhythm studies in small animals exposed to high voltage electric fields. These and other biological studies provided data that is highly relevant to the evaluation of health risks to humans when exposed to high-strength electric fields.
- Completed basic theoretical work on threshold voltage and maximum operating stresses for selected high-voltage insulation systems. The results of this are being transferred to the private sector and will lead to future high voltage insulating systems with greatly improved lifetimes.
- Determined the mechanisms for operation of advanced zinc-oxide insulators from an analysis of its fundamental properties. The results were used to produce components for protection of equipment from transient voltage spikes include lightning.
- Developed novel load-flow mathematical and computerized methods and fast-state estimation techniques for identifying power systems instabilities allowing for the first time at or near real-time analysis of changing system conditions.
- Completed development of singular perturbation theory for analyzing network transients, to give indication of impending network instability.

The EES program as constituted in FY 1986 has research programs in:

- electric field effects to determine the impact of exposure to high-voltage a.c. and d.c. electric and magnetic fields on living tissue and whole bodies.
- electromagnetic pulse (EMP) derived from high altitude and ground-level nuclear bursts and the potential impact on the Nation's civilian electric network.
- reliability to maintain and improve the Nation's electric power systems while reducing the per-unit capital cost. System stability and restoration after failure are central to this work.
- materials research focused on interfacial phenomena in liquid and solid dielectrics and semiconductors.
- superconducting power technologies with transfer of some of the results to ambient systems.

- performance verification of advanced batteries for utility load leveling.

Recent accomplishments of the Energy Storage research program include:

- Obtained encouraging results on a thermally regenerative electrochemical system employing sodium as a working fluid to produce electricity from heat with no moving parts. The work has now been transferred and is funded by DOE Industrial and Solar Thermal Programs for further development.
- Confirmed high catalytic properties of heat treated metal-organic based components which will replace expensive, scarce precious metals in various applications, including air batteries and fuel cells. Using these catalytic components, 1,950 simulated driving cycles have been successfully completed for vehicle batteries.
- Increased the life of carbon in electrochemical cells by reducing the carbon porosity, which had been identified as a major problem.
- Developed a zirconia-toughened beta double prime (beta") -alumina for use as an electrolyte in the sodium/sulfur cells. The new electrolyte has greater strength than that of pure beta"-alumina, and improved resistance to cracking.
- Completed a computer simulation and model of cell-crystallizer interaction that is a critical step in determining an optimal design for an aluminum/air battery.
- Identified a new sodium/sulfur system has been identified with energy density in excess of 350 Wh/kg compared to the present system of 120 Wh/kg. The Department of Defense is adapting this sodium/sulfur battery technology for use in satellite batteries.
- Completed laboratory evaluation of performance characteristics of mixed refrigerants in clathrate thermal storage during charging and discharging cycles. These studies are part of the effort to develop an efficient heat pump/cool storage system capable of shifting consumption from on-peak to off-peak hours for air conditioning applications.
- Completed evaluation of encapsulation processes for a low-cost form-stable silicon-aluminum eutectic storage medium for use in high-temperature rapid-cycling applications.
- Completed the first long-cycle test of the deep aquifer heat storage facility at the University of Minnesota with the successful elimination of salt precipitation problems. Transferred data to private sector.
- Completed two annual long-term chill storage cycles for air conditioning at the University of Alabama and initiated data analysis.
- Verified in the laboratory an intermittent galvano-electric cooling effect for a biased thin film semiconductor. This accomplishment represents a potential first step in the development of a solid-state heat pump storage device.
- Completed integration of an advanced solid polymer electrolyte water electrolyzer module at the Brookhaven National Laboratory integrated test bed for use on photovoltaic systems.
- Successfully demonstrated methods for applying polymer coatings to semiconductors to decrease photo-corrosion on the photochemical production of hydrogen.
- Identified carbon monoxide as a minor gas additive to hydrogen to prevent embrittlement at high pressures in ordinary pipeline steels.

The STOR program as constituted in FY 1986 has research in:

- optimizing the strength/resistivity ratio of Beta"-alumina by using transformation toughening. This work is critical in the development of long life for the electrolyte in the sodium-sulfur battery.
- investigating the properties of conductive polyethylene oxide. The development of a new type of high-energy-density battery could follow this work.
- Investigating the cause of dendritic deposition in flow batteries that use aqueous zinc-halide solutions. This work is in support of the development of the zinc-bromine battery.
- performing research to advance the development of molten salt batteries. Such batteries could have a very long cycle life.
- exploring molten-salt electrodeposition and chemical vapor deposition for preparation as corrosion-resistant coating on low-carbon steel. This could lead to the development of containers for batteries that have highly corrosive chemicals.
- investigating new concepts for metal electrodes and air electrodes in metal-air cells and conducting a comparative analysis for their application in electric vehicle. Also included is supporting research in the development of the aluminum-air battery.
- evaluating and developing new materials for use in high-performance secondary storage batteries.
- investigating high-temperature water electrolysis to produce hydrogen. When developed, the electrical requirements for this method of energy storage are projected to be about one-half those of conventional electrolysis methods.
- performing R&D on thermal storage with cost-effective and efficient energy transfer techniques including direct-contact methods. The cost of energy transfer or heat exchange in and out of storage is a major problem in commercializing thermal storage technologies.
- investigating selected advanced storage concepts including solid-state cooling/storage devices.

	Adjusted FY 1986 Appropriation	FY 1987 Request	Net Change
Electric Energy Systems	$11,548,000	$7,619,000	$3,929,000

The program content provides for research to build a technology base which will lead to advanced concepts and materials for future electric networks to meet the National security need for a reliable electric supply and the health and safety of society. This program has been evolving away from equipment orientation to more basic and applied research needed to make major improvements in future electric systems. The work supports research at National Laboratories, universities, and corporate laboratories.

Specifically, the EES program encourages and supports research directed to resolving mid- to long-term problems which will ensure that the biological health effects and risks to life forms exposed to high voltage electric and magnetic fields are well understood and mitigated; provide options that will ensure appropriate system reliability and the efficient use of capital resources during the expansion of the Nation's future electric network; provide electric power over a wide range of system conditions including both normal and emergency situations, as well as improvements needed for National security; and improve the efficiency of electric systems through the development of new materials, advanced controls and new design concepts. The EES program continues to support research in three specific activities: Electric Field Effects, Reliability R&D, and Systems Technology.

Electric Field Effects research will provide a technology base for a greater understanding into the potential health effects and risks to humans, plants, and animals when exposed to high-voltage transmission systems. The ultimate objective is to provide data to determine whether the more efficient and reliable high-voltage systems can be employed with minimum impact to the public and the environment. Identifying the biological effects and determining the interaction of biological mechanisms producing those effects and developing a methodology to analyze human risk are research activities that must be performed if realistic and logical decision are to be made by the public or regulating bodies.

The budget request will provide for the continuation of the highest priority biological a.c. and d.c. research programs to establish an objective scientific data base of electric and magnetic field effects, relating animal data to potential human hazards. The a.c. program will include analyses of the effects of a.c. magnetic fields and the continuation of the initiative between the Central Research Institute of the Electric Power Industry (CRIEPI) of Japan and the DOE to study the possible behavioral effects of high-voltage electric fields upon non-human primates. The objective of this multi-project international agreement is to perform research on the effect of field intensity on animals. Also under this agreement and under separate contracts, research will be supported on the effects of chronic exposure to 60 Hz electric fields. The results of these projects will ultimately be used to assist predicting the presence or absence of hazards to humans. In addition the a.c. program will continue developing risk analysis methodologies of exposure to a.c.-induced electric and magnetic fields. The d.c. program research will continue to investigate mechanisms interacting within the respiratory system due to exposure to high-voltage d.c. systems as well as research to develop the d.c. risk analysis methodology.

The budget request permits the Reliability R&D program to continue at a reduced rate. The research focuses on concepts and methods needed to plan and operate future more complex electric energy systems, during all normal and emergency conditions. The increase in complexity is being driven by National security and economics, including the need for more extensive interconnections between operating areas, the continual tightening of constraints (e.g., operating closer to capacity limits, expensive financing), and the development of and integration into the system of advanced system control and protection technologies which in themselves are very complex.

The FY 1987 funding will specifically permit a second level electromagnetic pulse (EMP) assessment of potential system change to continue on a stretched out schedule through a continuation of the principal on-going contract. Research on options to improve the reliability of the network or suppress the transient will however be postponed. The normal/emergency operating concepts project will continue; specifically, research for the on-line detection and recognition of system inabilities. Research on posturing strategies as well as adaptive relays for the protection of large networks will be delayed. There is no request for research into failure mechanisms.

The Systems Technology research area, designed to provide the knowledge and technology base to encourage substantial improvements in economics and extended component capability in future electric systems will be significantly changing in FY 1987. The long-term goal is to develop the capability and a technology base to integrate system functions that will ultimately permit optimization of all types of energy sources. The research program design was on developing new materials which will provide more efficient and reliable options for future components, and on developing a U.S. technology base to meet severe foreign competition.

In FY 1987 a limited materials technology base will be continued concentrating this year on interfacial phenomena in liquid dielectrics and promising semiconductor materials. The results of this project will ultimately aid the Nation's industries to develop and market equipment with superior life cycle costs. It could also lead to the development of new equipment presently not feasible because of material property constraints. The development of advanced automation and data processing concepts (i.e., Athens Automation and Control Experiments, communications/data processing trade-off studies and investigations of the applicability of fiber optics) will be closed-out as will the research activities of the superconductivity and ambient cable technologies. Documentation and final reports will be completed with accumulated data and information prepared and made available for historic reference.

	Adjusted FY 1986 Appropriation	FY 1987 Request	Net Change
Program Direction............................	$356,000	$350,000	$6,000

The funding will provide for 5 FTE personnel which is required to effectively plan and manage the Electric Energy Systems research program.

	Adjusted FY 1986 Appropriation	FY 1987 Request	Net Change
Energy Storage	$17,292,000	$8,600,000	$-8,692,000

The primary aim of the Energy Storage research program is to provide a technology base that will assist the final development and commercialization of advanced storage technologies. The request which substantially alters the portfolio toward a more basic and fundamental research agenda will provide for the continuation of research of advanced energy storage and other electrochemical systems. Ultimately, this research will provide the capability to utilize renewable energy resources and keep abreast of international technology development of advanced energy storage systems. This research also will contribute to the National security needs for a reliable energy supply.

The energy storage program ranges from more fundamental research, traditionally performed at universities, to exploratory development of technical concepts. The program is a coordinated cooperative effort conducted at National laboratories, universities, and private laboratories. A vital part of the electrochemical energy storage program is the technology base research which includes efforts to evaluate new systems, materials, and components. There will be a phase down for technology core research specifically on currently active development efforts.

The Electrochemical Program is divided into two subprograms:

Technology Base Research - Research is conducted on electrochemical systems that are projected to exceed the goals of systems in the development stage. These activities support fundamental research into the underlying principles applicable to batteries and electrochemical systems and existing electrochemical energy storage and conversion systems and provide the mechanisms for the evolution and development of new systems. During FY 1987 activities in this area will concentrate on:

- Electrochemical phenomena - Providing a better understanding of the complex phenomena that limit the performance and lifetime of electro-chemical systems. The work will continue to perform research on: the morphology of electrodes under continued cycling, kinetics of diffusion in electrolytes, and concurrent parasitic reactions occurring during cell operation.

- Materials and components - Developing improved materials and new components for electrodes, electrolytes, polymeric separators, and current collectors required to advance or improve energy storage technology.

- Electrocatalysis - Investigating new catalysts for electrochemical energy conversion systems, in both alkaline and acid media, and acquire atomic level understanding of complex electrochemical reactions of electrode surfaces.

- Advanced battery research - Continue studying advanced lithium batteries with high specific energy, and the capability to operate at ambient temperatures with emphasis being on rechargeable lithium electrodes.

- Electrochemical conversion - Continue investigating small fuel cells which offer an efficient means for utilizing hydrogen (produced on the vehicle from methanol or ammonia) and could be employed as a power source for "unlimited-range" electric vehicles. Current technical limitations include system size and cost, as well as response time to power demand transients.

Exploratory Technology Development - Exploratory technology development and testing provides for the initial development of those electrochemical systems which have been shown to be scientifically feasible by technology base research activities. The goal is to perform core technology research necessary to provide for orderly evaluation of batteries for use in electric and hybrid vehicles, utility load leveling and dispersed energy storage applications. Analysis of evaluation data provides insight into other materials and components R&D required to enhance overall performance. The Exploratory Technology Development activity in FY 1987 will focus entirely on completing sodium/sulfur core technology research.

- Sodium/sulfur Technology (Alkali Battery Research) - Research on high energy content sodium/sulfur batteries for electric vehicles and load leveling applications will continue as part of the third and final year of the core technology development project. Emphasis will be on elimination of freeze-thaw failure, improved thermal management in batteries, and lower cost corrosion-resistant containers. The major goal is to increase the reliability and life of the system while also reducing the costs.

The Thermal and Mechanical Storage program is divided into two subprograms listed below. The purpose of this research program is to provide the technology base for the more effective use of thermal energy resources and improving the efficiencies of chemical/hydrogen systems. These technologies will permit energy conversion or fuel substitution in transportation, residential and commercial buildings, industry, and electric utility areas.

Chemical/Hydrogen Production and Storage. The aim of this effort is to develop hydrogen base technologies for establishing a link between solar and other inexhaustible resources and the load centers of the future. The long-range baseline program addresses two major research activities: 1) primary resource conversions to hydrogen as an energy carrying fuel and chemical commodity, and 2) bulk and mobile storage options for hydrogen. Current emphasis is placed on the development and characterization of high-temperature water vapor electrolysis cells operating as a process with a high probability of successfully meeting objectives of efficient water dissociation with analyses projecting thermal efficiencies approaching 50%. Alternatives to high-temperature electrolysis include intermediate temperature (300°-600°C) electrolysis and photochemical processes. Hydrogen storage efforts, currently at early research stages will continue to identify advanced metal hydrides and cold storage on catalyzed carbon. Research will also be performed on advanced hydrogen liquefaction processes based on thermally-driven metal hydride systems.

Thermal Energy Storage Research. The diurnal thermal program will continue to include research to develop the technology base for thermal storage systems. Activities focus on diurnal storage systems which store heat and cold using inclusion compounds, such as freon hydrate or phase-change materials in packed beds and slurry systems. Dual-temperature systems with transition temperatures using form-stable phase-change materials with direct-contact heat exchange will continue. Innovative concepts such as solid state heat pumps and containment techniques for high-temperature as well as solar thermal storage will be explored.

	Adjusted FY 1986 Appropriation	FY 1987 Request	Net Change
Program Direction...............................	$327,000	$399,000	$72,000

Funding will support six full-time-equivalent positions needed to provide management of the Energy Storage Program.

Nuclear

DEPARTMENT OF ENERGY
FISCAL YEAR 1987 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY RESEARCH AND DEVELOPMENT
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DEPARTMENT OF ENERGY
FY 1987 CONGRESSIONAL BUDGET REQUEST
LEAD TABLE

NUCLEAR OVERVIEW

Energy Supply Research and Development
(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1985 Approp.	FY 1986 Approp. 1/	FY 1987 Base	FY 1987 Request	Request vs Base
Nuclear Energy Research and Development (NE)					
Operating Expenses......	$385,087	$357,019	$357,019	$307,520	$-49,499
Capital Equipment.......	19,725	13,181	13,181	14,580	1,399
Construction............	7,800	5,484	5,484	8,800	3,316
Subtotal..............	$412,612	$375,684	$375,684	$330,900	$-44,784
Remedial Action and Waste Technology					
Operating Expenses......	$168,845	$228,220	$228,220	$291,200	$ 62,980
Capital Equipment.......	1,520	1,827	1,827	2,900	1,073
Subtotal..............	$170,365	$230,047	$230,047	$294,100	$ 64,053
Civilian Radioactive Waste R&D					
Operating Expenses......	$ 23,386	$ 13,091	$ 13,091	$ 6,500	$ -6,591
Capital Equipment.......	2,500	2,973	2,973	--	-2,973
Subtotal..............	$ 25,886	$ 16,064	$ 16,064	$ 6,500	$ -9,564
TOTAL					
Operating Expenses......	$577,318	$598,330	$598,330	$605,220	$ 6,890
Capital Equipment.......	23,745	17,981	17,981	17,480	-501
Construction............	7,800	5,484	5,484	8,800	3,316
Grandtotal............	$608,863	$621,795 1/	$621,795	$631,500	$ 9,705
Staffing Total FTE's......	187	161	161	154	-7

Appropriation: Sec: 31, P.L. 83-703, Sec. 309(a), P.L. 95-91, and P.L. 96-567

1/ Adjustments to the FY 1986 Appropriations are described in the table on the following pages.

DEPARTMENT OF ENERGY
FY 1987 CONGRESSIONAL BUDGET REQUEST
ADJUSTMENTS TO FY 1986 APPROPRIATION
(Dollars in Thousands)

Program	FY 1986 Confer	Gen Reduct	Mgmt Init	Paycost Restore	FTE General Reduct	Gramm Rudman Hollings	ES&H Trans/ Reprog	Sub Total	Comp Admjts	Total
NUCLEAR										
Improved LWR Technology										
Improved LWR Development-OE	13,000					-491		12,509	-12,509	0
Three Mile Island R&D-OE	32,300					-1,221		31,079	-31,079	0
Sub Total-Impr LWR Tech	45,300	0	0	0	0	-1,712	0	43,588	-43,588	0
Advanced Converter Reactor										
Advanced LWR-OE	4,750	0	0	0	0	-180	0	4,570	-4,570	0
Advanced HTGR-OE	31,000		-250			-1,162		29,588	-29,588	0
-CE	1,000					38		962	-962	0
Subtotal-Adv HTGR	32,000	0	-250	0	0	-1,200	0	30,550	-30,550	0
Liquid Metal Converter-OE	70,000		-3,750			-2,504		63,746	-63,746	0
-CE	200					-8		192	-192	0
-PLT	1,000					-38		962	-962	0
Subtotal-Liquid Metal Conv	71,200	0	-3,750	0	0	-2,550	0	64,900	-64,900	0
Subtotal-Advanced Conv Rea	107,950	0	-4,000	0	0	-3,930	0	100,020	-100,020	0
Advanced Breeder Reactors										
Breeder Components Tech-OE	6,700					- 253		6,447	-6,447	0
Fuel Performance & Supply-OE	22,900		-800			-835		21,265	-21,265	0
-CE	2,000					-76		1,924	-1,924	0
Subtotal-Fuel Perf	24,900	0	-800	0	0	-911	0	23,189	-23,189	0
Reactor Core Tech-OE	4,900					-185		4,715	-4,715	0
-CE	2,320					-88		2,232	-2,232	0
Subtotal-Reactor Core Tech	7,220	0	0	0	0	-273	0	6,947	-6,947	0
Test Facilities-OE	98,200	-728			-183	3,683	-50	93,556	-93,556	0
-CE	4,480					-169		4,311	-4,311	0
-Plt	1,800					-68		1,732	-1,732	0
Subtotal-Test Facilities	104,480	-728	0	0	-183	-3,920	-50	99,599	-99,599	0
Clinch River Breeder Reactor	0	- 19,301	0	-9,699	0	0	0	-29,000	29,000	0
Nuclear Fuel Cycle-OE	16,500	0	0	0	0	-624	0	15,876	-15,876	0
Subtotal-Advanced Breeder	159,800	-20,029	-800	-9,699	-183	-5,981	-50	123,058	-123,058	0
Water Cooled Breeder										
Defueling-OE	5,100					-193		4,907	-4,907	0
Core Evaluation-OE	14,600					-552		14,048	-14,048	0
Subtotal-Water Cooled Brd	19,700	0	0	0	0	-745	0	18,955	-18,955	0

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Program	FY 1986 Confer	Gen Reduct	Mgmt Init	Paycost Restore	FTE General Reduct	Gramm Rudman Hollings	ES&H Trans/ Reprog	Sub Total	Comp Admjts	Total
Civilian Reactor Development										
Reactor Devel Generic Suppt	2,625					-99		2,526	-2,526	0
Safeguards & Security-OE	5,750					-217	-650	4,883	-4,883	0
-Plt	900					-34		866	-866	0
Subtotal-Safeguards & Sec	6,650	0	0	0	0	-251	-650	5,749	-5,749	0
Reduced Enrich for Test Reac	5,200					-197		5,003	-5,003	0
Program Direction-OE	7,400					-280		7,120	-7,120	0
Subtotal-Civ Reactor Devel	21,875	0	0	0	0	-827	-650	20,398	-20,398	0
Advanced Nuclear Systems										
Space & Spec Appl-OE	20,455					-773		19,682	-19,682	0
-CE	1,700					-64		1,636	-1,636	0
Subtotal-Space & Spec Appl	22,155	0	0	0	0	-837	0	21,318	-21,318	0
Program Direction-OE	845	0	0	0	0	-32	0	813	-813	0
Subtotal-Adv Nuclear Sys	23,000	0	0	0	0	-869	0	22,131	-22,131	0
Defense Nuclear Energy Program										
Space Reactor Project-OE	12,610					-477		12,133	-12,133	0
-Plt	2,000					-76		1,924	-1,924	0
Subtotal-Space Reactor	14,610	0	0	0	0	-553	0	14,057	-14,057	0
Terrestrial Applications	2,500	0	0	0	0	-94	0	2,406	-2,406	0
Program Direction-OE	390	0	0	0	0	-15	0	375	-375	0
Capital Equipment	2,000	0	0	0	0	-76	0	1,924	-1,924	0
Subtotal-Def Nucl Energy	19,500	0	0	0	0	-738	0	18,762	-18,762	0
Nuclear Waste Technology										
Low Level Waste-OE	4,650					-176		4,474	-4,474	0
-CE	100					-4		96	-96	0
Subtotal-Low Level Waste	4,750	0	0	0	0	-180	0	4,570	-4,570	0
Waste Treatment Tech-OE	6,000					-227		5,773	5,773	0
-CE	450					-17		433	-433	0
Subtotal-Waste Treat Tech	6,450	0	0	0	0	-244	0	6,206	-6,206	0

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Program	FY 1986 Confer	Gen Reduct	Mgmt Init	Paycost Restore	FTE General Reduct	Gramm Rudman Hollings	ES&H Trans/ Reprog	Sub Total	Comp Admjts	Total
Civ Byprod & Beneficial Use	5,000	0	0	0	0	-189	0	4,811	-4,811	0
Program Direction-OE	500	0	0	0	0	-19	0	481	-481	0
Subtotal-Nuclear Waste Tec	16,700	0	0	0	0	-632	0	16,068	-16,068	0
Civilian Waste R&D										
Spent Fuel Storage-OE	7,800	-10				-294		7,496		7,496
-CE	1,100					-42		1,058		1,058
Subtotal-Spent Fuel	8,900	-10	0	0	0	-336	0	8,554	0	8,554
Alt Disposal Concepts-OE	5,500					-208		5,292		5,292
-CE	2,000	-10				-75		1,915		1,915
Subtotal-Alt Disposal Conc	7,500	-10	0	0	0	-283	0	7,207	0	7,207
Program Direction-OE	325	-4			-6	-12		303		303
Subtotal-Civ Waste R&D	16,725	-24	0	0	-6	-631	0	16,064	0	16,064
Remedial Actions										
Surplus DOE Facilities-OE	41,350					-1,563		39,787	-39,787	0
-CE	150					-6		144	-144	0
Subtotal- Surplus DOE Fac	41,500	0	0	0	0	-1,569	0	39,931	-39,931	0
Formerly Utilized Sites-OE	19,500					-737		18,763	-18,763	0
-CE	200					-8		192	-192	0
Subtotal-FUSRAP	19,700	0	0	0	0	-745	0	18,955	-18,955	0
Uranium Mill Tailings-OE	94,000					-3,553	-50	90,397	-90,397	0
-CE	1,000					-38		962	-962	0
Subtotal-UMTRAP	95,000	0	0	0	0	-3,591	-50	91,359	-91,359	0
West Valley-OE	64,000	0	0	0	0	-2,419	0	61,581	-61,581	0
Grand Junction-OE	900	0	0	0	0	-34	0	866	-866	0
Program Direction-OE	1,400	0	0	0	0	-53	0	1,347	-1,347	0
Subtotal-Remedial Actions	222,500	0	0	0	0	-8,411	-50	214,039	-214,039	0
Nuclear Energy R&D										
Light Water Reactors-OE									48,158	48,158
-CE									0	0
Subtotal-Light Water Reac	0	0	0	0	0	0	0	0	48,158	48,158
Advanced Reactor R&D-OE									123,432	123,432
-CE									5,118	5,118
-Plt									0	0
Subtotal-Adv Reactor R&D	0	0	0	0	0	0	0	0	128,550	128,550

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(Dollars in Thousands)

Program	FY 1986 Confer	Gen Reduct	Mgmt Init	Paycost Restore	FTE General Reduct	Gramm Rudman Hollings	ES&H Trans/ Reprog	Sub Total	Comp Admjts	Total
Space & Defense Power Sys-OE									16,367	16,367
-CE									1,924	1,924
-Plt									1,924	1,924
Subtotal-Space & Defense	0	0	0	0	0	0	0	0	20,215	20,215
Advanced Nuclear Systems-OE									17,854	17,854
-CE									1,636	1,636
Subtotal-Advanced Nuc Sys	0	0	0	0	0	0	0	0	19,490	19,490
Facilities-OE									124,173	124,173
-CE									4,503	4,503
-Plt									3,560	3,560
Subtotal-Facilities	0	0	0	0	0	0	0	0	132,236	132,236
Water Cooled Breeder-OE									18,955	18,955
-CE									0	0
Subtotal-Water Cooled Brdr	0	0	0	0	0	0	0	0	18,955	18,955
Program Direction-OE	0	0	0	0	0	0	0	0	8,080	8,080
Subtotal Nuclear Energy R&D	0	0	0	0	0	0	0	0	375,684	375,684
Remedial Action & Waste Tech										
Formerly Utilized Sites-OE									18,763	18,763
-CE									192	192
Subtotal-FUSRAP	0	0	0	0	0	0	0	0	18,955	18,955
Grand Junction-OE	0	0	0	0	0	0	0	0	866	866
Surplus Facilities-OE									39,787	39,787
-CE									144	144
Subtotal-Surplus Facilities	0	0	0	0	0	0	0	0	39,931	39,931
Uranium Mill Tailings-OE								0	90,397	90,397
-CE									962	962
Subtotal-UMTRAP	0	0	0	0	0	0	0	0	91,359	91,359
West Valley-OE									61,581	61,581
-CE									0	0
Subtotal-West Valley	0	0	0	0	0	0	0	0	61,581	61,581

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FY 1987 CONGRESSIONAL BUDGET REQUEST
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(Dollars in Thousands)

Program	FY 1986 Confer	Gen Reduct	Mgmt Init	Paycost Restore	FTE General Reduct	Gramm Rudman Hollings	ES&H Trans/ Reprog	Sub Total	Comp Admjts	Total
Low Level Waste-OE									4,474	4,474
-CE									96	96
Subtotal-Low Level Waste	0	0	0	0	0	0	0	0	4,570	4,570
Waste Tech & Byproducts-OE									10,584	10,584
-CE									433	433
-Plt									0	0
Subtotal-Waste Tech & Bypr	0	0	0	0	0	0	0	0	11,017	11,017
Program Direction-OE	0	0	0	0	0	0	0	0	1,768	1,768
Subtotal-Remed & Waste Tech	0	0	0	0	0	0	0	0	230,047	230,047
Total Nuclear	653,050	-20,053	-4,800	-9,699	-189	-24,476	-750	593,083	28,712	621,795
All Other Energy Supply	1,376,221	-2,547	-12,200	-8,123	-400	-51,732	6,900	1,308,119	7,708	1,315,827
Subtotal-Gross Energy Supply	2,029,271	-22,600	-17,000	-17,822	-589	-76,208	6,150	1,901,202	36,420	1,937,622
General Reduction	-22,600							-22,600		-22,600
Prior Year Balances Applied:										
Nuclear-OE		19,301						19,301	-19,301	0
All Other Energy Supply		950						950	-950	0
Management Initiatives	-17,000							-17,000		-17,000
Prior Year Balances Applied:										
Nuclear-OE								0		0
All Other Energy Supply-PLT			6,470					6,470	-6,470	0
Prior Yr Balances Trans From Other Accounts	-217,400							-217,400		-217,400
Other Adjustments:										
Paycost Restoration:										
Prior Year Balances Applied:										
Nuclear-OE				9,699				9,699	-9,699	0
Paycost Absorbed in Other Accounts				6,281				6,281		6,281
Paycost Absorbed in Energy Supply				1,842				1,842		1,842
Totals	1,772,271	-2,349	-10,530	0	-589	-76,208	6,150	1,688,745	0	1,688,745

DEPARTMENT OF ENERGY
FY 1987 CONGRESSIONAL BUDGET REQUEST
ENERGY SUPPLY RESEARCH AND DEVELOPMENT
PROGRAM OVERVIEW

Nuclear

The Department of Energy's (DOE's) nuclear energy supply research and development effort consists of two major programs: Nuclear Energy Research and Development and Remedial Action and Waste Technology.

Nuclear energy program activities are essential elements in achieving a national goal of providing an adequate, strong, secure and stable supply of energy at reasonable cost. Nuclear energy constitutes one of the key elements in the Nation's energy triad, along with fossil and renewable energy resources, and should continue to provide a major contribution to our national energy needs. Continuing nuclear energy research and development will (1) help assure nuclear energy contributes to our civilian needs for a balanced and secure domestic energy base as well as our emerging military needs to meet national security objectives, and (2) provide the technical and industrial base for continued deployment of advanced nuclear technologies in the future.

Nuclear energy research and development program emphasis and priorities are being shifted significantly consistent with increasing space and defense nuclear energy needs, currently anticipated timing for commercial deployment of advanced reactors beyond light water reactors, and limited R&D resources. The primary emphasis in advanced reactor R&D is to support national security requirements, including the Strategic Defense Initiative. Certain benefits that accrue from this R&D work will be applied to future civilian reactor development efforts and some complementary civilian reactor base technology programs will continue. Since application of improved "state of the art" light water reactors (LWR) represent the most likely path to revitalizing the nuclear power option, emphasis is on supporting a process leading to enhanced safety, rationalized licensing, and certification of advanced LWR designs. Supporting all of these R&D efforts will be the continued operation of the unique test facilities and analytical laboratories required for developing and verifying advancements in reactor systems, fuel, components and power conversion systems.

Consistent with the Department's commitment to assure protection of the public and the environment, projects and program activities will continue to be pursued in fulfillment of statutory requirements to conduct remedial actions at abandoned radioactively contaminated sites and facilities. Remedial action projects will be pursued to completion on schedules consistent with program priorities and funding support. The number of projects under way and the scope of work is expanding as a number of these projects move from the planning stage to the implementation stage. Technical assistance will continue to be provided to States to manage low-level radioactive waste and implement formation of regional compacts.

Funding and support of the Energy Supply R&D programs discussed below will lead to: a more stable and predictable reactor licensing process and an improved safety and technological basis for regulatory requirements; additional emphasis in high risk areas of innovation which can simplify the design, construction, and operation of both the current and improved generations of LWR's; development of nuclear power supplies for emerging national security missions involving space and terrestrial applications; a complementary but more limited technological and industrial base that will encourage future deployment initiatives and decisions for advanced commercial reactors by the private sector; and the fulfillment of remedial action and waste technology projects to provide further protection to the environment and public health and safety.

Nuclear Energy Research and Development

The Nuclear Energy Research and Development program develops, in cooperation with industry, advanced technology for improved light water reactor powerplant safety and efficiency; conducts research and development on advanced reactor systems for defense and commercial applications; and operates R&D facilities that support the Nation's nuclear programs. The R&D Program consists of the following activities: Light Water Reactors, Advanced Reactor R&D, Space and Defense Power Systems, Advanced Nuclear Systems, Facilities, and Water Cooled Breeder.

A discussion of these activities that comprise the Nuclear Energy Research and Development budget follows.

Light Water Reactors:

The Light Water Reactor (LWR) Technology activity consists of three interrelated elements: LWR Safety and Licensing; Advanced LWR Technology; and Three Mile Island (TMI) R&D.

The Safety and Licensing element encompasses efforts to improve the operation and availability of LWR's, extend plant lifetimes, improve plant productivity, enhance plant safety, and improve plant licensability. The key features of the activity are: redefinition of the Federal government's regulatory role and enhancing this role with supporting LWR technical R&D activities; establishment of a technology base and prelicensing of important plant improvements to enable the use of current technologies in nuclear powerplants that are presently limited by regulatory procedures; assessment of severe accident source-term issues directed at reducing current source terms; development of new risk-based licensing approaches to support a more stable and predictable licensing process; establishment of a regulatory/technology base for extending Light Water Reactor licenses beyond the current Nuclear Regulatory Commission limit of 40 years; and the improvement of the availability and productivity of operating reactors.

Several Advanced LWR designs are being evaluated as part of complementary DOE and industry research and development programs to identify improvements to current light water reactors. Decisions and actions for deployment of commercial reactors remains with the private sector. The Department's role is to augment industry efforts and to act as a catalyst for innovative improvements to advanced light water reactor designs, which will lessen the future uncertainty and complexity with which regulators must contend, enhance the safety and productivity of reactors, and assure the availability of advanced technology for future power decisions.

The demonstrated removal of the remaining technical, licensing, and institutional impediments to the construction and operation of next generation Light Water Reactors is the overall objective which the complementary government/industry Advanced LWR activities address. A milestone in the pursuit of this objective will be the NRC certification of at least two Advanced Light Water Reactor (ALWR) systems in approximately 5 years. The pursuit of this objective will have the effect of focusing and guiding the DOE and industry efforts in nuclear licensing and institutional reform, safety research, component and systems development and test, and licensing of advanced systems.

TMI support in FY 1987 will continue to focus on developing technology for improving the capability of civilian nuclear powerplants to safely recover from accidents, and conducting research and development to enhance substantially the understanding of factors which improve the safe operation of LWR plants. Fuel removal, which the utility began in the fall of 1985, should be completed by the end of FY 1987. The damaged core will be shipped to the Idaho National Engineering Laboratory (INEL). Portions of the core will be examined at INEL and other laboratories to obtain data needed to improve the current understanding of the progression of severe accidents in addition to the concomitant behavior of the core materials and fission products. The important information garnered from this R&D, based upon actual plant experience, can be used in current and future design, licensing, and regulatory activities. DOE's TMI activities will be completed in FY 1988.

Advanced Reactor R&D:

The Advanced Reactor R&D activity will conduct tests, experiments, and studies in advanced reactor research to support a continuum of both civilian and military energy requirements. FY 1987 will serve as a transition period during which military power needs will be identified, certain activities will be phased out, and the R&D emphasis will be shifted from satisfying primarily the needs of the civilian sector for advanced reactors to satisfying primarily the space and terrestrial power needs for the military.

Though the program emphasis changes, the on-going work and existing resources should provide a complementary and adequate technical base for any future initiative, as led by the private sector, to deploy advanced nuclear technologies in the commercial sector. The Advanced Reactor R&D program will be reoriented to: provide technology to meet emerging and existing NASA or military space and terrestrial nuclear power needs while commercial-specific designs and R&D are phased down; assure the maintenance of a technical, testing, analytical, and design infrastructure to assure capability to respond to the need for civilian nuclear power in the future and transfer appropriate advanced reactor technology to industry for utilization in a future advanced civilian reactor program. The activities envisioned for FY 1987 will preserve the most important elements of the existing program, including some international activities, while making the technical capability of the laboratories and test facilities available for utilization in near-term space and defense applications.

Space and Defense Power Systems:

The Space and Defense Power Systems activity is an integrated set of R&D elements that will develop nuclear power sources to support emerging Department of Defense requirements for a variety of terrestrial and space missions, including the Strategic Defense Initiative Office. It will provide the design, development and supporting technology for building compact, high performance reactors for space and terrestrial applications and dynamic isotope power systems for space application. This activity consists of low power and multi-megawatt power systems. The low power systems include the SP-100 space reactor power system (up to about 1 MWe), the 15 KWe terrestrial Small Nuclear Power Source Demonstration, and the Dynamic Isotope Power System (about 1 to 10 KWe) for space use. The multi-megawatt systems include space reactors that must produce several megawatts of continuous electric power for sustained time periods, as well as hundreds of electrical megawatts for short durations; and a 10 MWe terrestrial powerplant. The USAF has determined that nuclear power may provide a cost-effective and militarily superior source of power for certain missions and has also generated a Statement of Operational Need for compact space power.

The SP-100 project, a multi-hundred kilowatt electric class space reactor power system technology project, will initiate system design, development, test, and facility modification efforts leading to a ground test of a 300 KWe liquid metal cooled space reactor with thermoelectric power conversion, so that SP-100 technology flight readiness can be demonstrated by 1991. Technology activities and scaling studies will also be performed to ensure the application of the SP-100 design over a broad power range, approaching 1 MWe. The Small Nuclear Power Source Demonstration project involves the development of a 15 KWe terrestrial reactor power system as an alternate power supply to update the Distant Early Warning (DEW) line across Northern Canada. Efforts on this project will involve the continued design and subsequent fabrication of a prototype reactor for long-term unattended operations. A demonstration unit should be on test in FY 1987, while a prototype unit may be installed at a North Warning System radar site in FY 1988. The Dynamic Isotope Power System involves design and subsequent development and testing of a rugged radioisotopic heat source with high-efficiency dynamic energy conversion to meet military space requirements.

The Multi-megawatt Space Reactor project will involve the identification and evaluation of very high performance reactor concepts and the development of associated critical technologies in support of SDI space prime power requirements. The Multi-megawatt Terrestrial Power program will continue the design of a nuclear powerplant for ground based SDI assets and other high priority DOD weapon systems and installations which require a hardened and reliable power supply for overall weapon system operability and credibility.

Though primarily designed to meet national security requirements, the reactor and isotope technologies developed in these programs may well have applicability for future space and terrestrial commercial systems.

Advanced Nuclear Systems:

Radioisotope power supplies have been successfully utilized for a number of years; the program thrust now is to improve the technology so as to provide lighter weight, highly reliable, and more efficient power supplies for terrestrial and space application. Nuclear power is an enabling technology for many missions requiring light-weight, highly reliable power supplies up to the kilowatt range.

This activity provides nuclear radioisotope power sources to meet civilian and military applications. For example, two NASA (National Aeronautics and Space Administration) spacecraft launches scheduled for the spring of 1986 (Ulysses and Galileo) will rely on nuclear radioisotope power supplies for all on-board electricity. Likewise, future NASA exploratory interplanetary space launches will rely on advanced radioisotope thermoelectric generators (RTG) to supply electrical power and radioisotope heater units to supply heat to the spacecraft experiments. Improved heat source manufacturing techniques, refractory metal encapsulation developments, and modular system designs will be pursued to enhance the quality of delivered products that meet user requirements and application configurations. The DOE's isotope technology development element is aimed at improving power system efficiency and compactness to enhance overall mission effectiveness and safety.

Fuel form production and encapsulation facilities, along with heat source assembly and testing facilities, will be operated for functional tests and maintained in a state of production readiness to meet military application delivery requirements beginning in FY 1989. Long lead procurements and fabrication of heat source components will begin in support of production requirements for the military 3-watt RTG program, which is a new class of low wattage RTG's for national defense missions. Other system support facilities will be operated, tested and maintained in a state of production readiness to support production operations planned in FY 1988.

Facilities:

The United States operates some of the most advanced and sophisticated nuclear test facilities in the world today for advanced power generation reactors, fuels, components, and materials. The facilities provide essential testing capabilities required for the development of safe, reliable, environmentally acceptable and efficient nuclear energy power sources that will be suitable for space, military and civilian applications. These facilities are also used in: development of fusion technology; cooperative technology programs with other countries; non-nuclear energy programs such as coal, solar, and geothermal; and conducting tests for other Government and private sector organizations such as the Electric Power Research Institute and U.S. Nuclear Regulatory Commission (NRC). FY 1987 will be a transition year for the nuclear reactor test facilities, reflecting the change in program emphasis to support primarily military space and terrestrial energy near-term requirements. Facility operations are directed at conducting required tests to support and verify advances in fuels, core systems, materials, safety, components, and instrumentation and control systems in support of defense, space, and civilian energy program requirements. Facilities are also used to support international agreements and non-nuclear program activities.

Synergistic benefits will accrue to all reactor development projects through the completion and documentation of test results.

A cost sharing approach is being established that provides a more equitable distribution of costs among facility users. This cost sharing approach will be partially implemented in FY 1987, with full implementation planned for FY 1988. Synergistic benefits will accrue to all reactor development projects through the conduct, analysis, evaluation and documentation of the facilities test programs.

Water Cooled Breeder Reactor Technology:

One of the variations of nuclear technology is the use of a uranium-233/thorium fuel cycle. The Water Cooled Breeder Reactor activity has the mission of developing technology that will significantly improve the efficiency of utilizing nuclear fuel resources. The specific objective is to prove that fuel breeding can be achieved in a light-water reactor using the uranium-233/thorium fuel system. The focus of activity efforts in FY 1987 will be to complete evaluation of the light-water breeder core removed from the Shippingport Atomic Power Station to verify breeding, thereby bringing this project to a conclusion in FY 1987.

Remedial Action and Waste Technology

The objectives of the Remedial Action and Waste Technology program are to treat or stabilize radioactive waste and to perform decontamination and decommissioning at contaminated DOE and legislatively authorized non-government facilities and sites; facilitate development of a reliable national system for managing low-level waste; and develop acceptable technologies for the treatment and immobilization of all types of radioactive waste. International cooperation has a significant role in the program, and cost sharing arrangements will be fulfilled and pursued when mutual benefits are identified. Major program activities in FY 1987 are: (1) the Formerly Utilized Sites Remedial Action Project; (2) the Grand Junction Remedial Action Project; (3) the Uranium Mill Tailings Remedial Action Project; (4) the Surplus Facilities Management Program; (5) the West Valley Demonstration Project (6) technical assistance to States and regions to assist them in developing new capacities for the disposal of low-level radioactive waste; and (7) civilian byproducts utilization and applications with primary emphasis on food irradiation.

The description of each of these activities is provided in the following sections.

Formerly Utilized Sites Remedial Action Project (FUSRAP):

The objective of this activity is to provide remedial actions at former nuclear processing facilities that became radioactively contaminated as a result of Manhattan Engineering District (MED) or Atomic Energy Commission (AEC) work, or have been specifically assigned to DOE by Congress. This project provides for removal of contaminated material from properties which are contaminated above current guidelines. The waste from cleanup work is, generally, stored temporarily on the facility site, which was the source of the contamination. Later, the source facility is decontaminated and the waste is either stabilized in place or removed to a host state disposal facility. In FY 1987, remedial action activities will concentrate on five high priority sites: Wayne, NJ; Maywood, NJ; Colonie, NY; Hazelwood, MO, and the St. Louis Airport Storage Site, MO. Remedial action will be initiated at the Albany, OR site and engineering, environmental assessments and other program efforts will continue at other sites and vicinity properties.

Grand Junction Remedial Action Project:

This project, authorized under Public Law 92-314, as amended, provides financial assistance on a cost sharing basis to the State of Colorado to limit radiation exposure resulting from the former use of uranium mill tailings for construction purposes in the Grand Junction, Colorado. This project will complete remedial action on all remaining properties in FY 1987. Final radiological surveys on decontaminated structures and program close-out will be accomplished in FY 1988.

Uranium Mill Tailings Remedial Action Project (UMTRAP):

This project, authorized under Public Law 95-604, covers remedial actions at 24 inactive uranium mill tailings processing sites and several thousand associated vicinity properties. This project will complete remedial action at the processing site and vicinity properties at Shiprock, NM, and Salt Lake City, UT; remedial actions will be continued at Lakeview, OR and Tuba City, AZ and initiated at Ambrosia Lake, NM, Durango, Grand Junction, Gunnison in CO, Mexican Hat, UT, and Riverton, WY; NEPA and engineering design activities at other sites will continue. The Department is proposing legislation to extend the period of authorization end date from March, 1990 to September, 1993. This proposed action is necessary to accommodate the large number of sites and vicinity properties that would be under construction simultaneously; and to incorporate the increased scope and nature of work required to comply with promulgated environmental, health and safety standards. There is no adverse health or safety impact to the public or environment as a result of the proposed change. The total estimated cost (TEC) of the project is projected to increase due to delays encountered in reaching agreement among the many parties involved in remedial action plans, actual site experience, and higher than anticipated costs to meet requirements of the EPA standards, particularly in satisfying ground water requirements and stabilizing tailings located in floodplains, or alternatively, relocating them to new disposal sites. The

Department is pursuing measures to reduce and control the costs for performing remedial actions.

Surplus Facilities Management Program:

The Surplus Facilities Management activity provides for the safe management and disposition of designated DOE facilities with an objective of returning to productive use, where appropriate, facilities and sites that have been decontaminated. In FY 1987 dismantlement operations will continue at the Shippingport Atomic Power Station. Remedial actions will begin at the Weldon Spring Site in Missouri and the Power Burst Facility in Idaho, while work will continue or be completed at a number of other facilities.

West Valley Demonstration Project:

Authorized under Public Law 96-368, this project will demonstrate the solidification of high-level radioactive waste at the Western New York Nuclear Service Center, near West Valley, New York. The West Valley Demonstration Project will complete non-radioactive testing of the Component Test Stand. Decontamination of several major shielded cells will be completed, allowing installation of equipment for waste processing and for high-level waste interim storage. Major procurements will be made to begin conversion of the Component Test Stand for radioactive operations to convert high-level liquid waste into borosilicate glass logs suitable for emplacement in the high-level waste repository, currently under development. Other associated activities will support and maintain the revised schedule of operations, with the start of high-level waste solidification planned for early FY 1989. FY 1987 will be the peak year for project funding based upon planned and scheduled expenditures for major equipment procurements and construction.

Low-Level Waste:

During FY 1987, the Low-Level Waste activity will provide technical support and assistance to States and regions for the development of new low-level waste disposal facilities. Assistance in correcting problems at existing disposal sites and in utilizing advanced or innovative methods for the treatment of low-level waste will be continued. The Low-Level Radioactive Waste Policy Amendments Act of 1985 assigns additional responsibilities to the Department relating to the management of civilian low-level waste, assistance to states and regions, and annual reporting requirements to Congress. These new responsibilities are being evaluated and will be satisfied consistent with available resources.

Waste Treatment:

Testing of the high-level waste vitrification system at Pacific Northwest Laboratory using radioactive material will be terminated and the system shut down in FY 1987. Reports on research results obtained in FY 1986 will be completed and commitments to the Federal Republic of Germany (FRG) will be met in accordance with the current DOE/FRG cooperative agreement.

Byproducts Utilization:

This activity will seek cooperative funding from the private sector for completion of several regional agricultural commodity irradiation projects. Efforts will continue for two facilities, funded from prior year appropriations, to develop and transfer technology for the beneficial uses of nuclear waste byproducts.

DEPARTMENT OF ENERGY
FY 1987 CONGRESSIONAL BUDGET REQUEST
LEAD TABLE
NUCLEAR ENERGY RESEARCH AND DEVELOPMENT

Nuclear
Energy Supply Research and Development - Operating Expenses
Energy Supply Research and Development - Plant and Capital Equipment
(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1985 Approp.	FY 1986 Approp.	FY 1987 Base	FY 1987 Request	Request vs Base
Nuclear Energy Research and Development (NE)					
Light Water Reactors					
Operating expenses A/ ...	$ 49,960	$ 48,158	$ 48,158	$ 41,000	$ -7,158
Capital Equipment	1,500	0	0	0	0
Subtotal	$ 51,460	$ 48,158	$ 48,158	$ 41,000	$ -7,158
Advanced Reactor R&D					
Operating expenses	$144,048	$123,432	$123,432	$ 47,000	$-76,432
Capital Equipment	14,690	5,118	5,118	2,500	-2,618
Subtotal	$158,738	$128,550	$128,550	$ 49,500	$-79,050
Space and Defense Power Systems					
Operating expenses	$ 8,722	$ 16,367	$ 16,367	$ 60,370	$+44,003
Capital equipment	50	1,924	1,924	6,280	+4,356
Construction	0	1,924	1,924	5,000	+3,076
Subtotal	$ 8,772	$ 20,215	$ 20,215	$ 71,650	$+51,435
Advanced Nuclear Systems					
Operating Expenses	$ 24,884	$ 17,854	$ 17,854	$ 20,600	$ +2,746
Capital Equipment	1,500	1,636	1,636	3,000	+1,364
Subtotal	$26,384	$ 19,490	$ 19,490	$ 23,600	$ +4,110
Facilities					
Operating Expenses	$124,088	$124,173	$124,173	$115,200	$ -8,973
Capital Equipment	1,985	4,503	4,503	2,800	-1,703
Construction	7,800	3,560	3,560	3,800	+240
Subtotal	$133,873	$132,236	$132,236	$121,800	$ -10,436
Water Cooled Breeder					
Operating Expenses	$ 25,000	$ 18,955	$ 18,955	$ 13,800	$ -5,155
Subtotal	$ 25,000	$18,955	$ 18,955	$ 13,800	$ -5,155
Program Direction					
Operating Expenses	$ 8,385	$ 8,080	$ 8,080	$ 9,550	$ +1,470
Subtotal	$ 8,385	$ 8,080	$ 8,080	$ 9,550	$ +1,470
Total					
Operating expenses	$385,087	$357,019	$357,019	$307,520	$-49,499
Capital equipment	19,725	13,181	13,181	14,580	+1,399
Construction	7,800	5,484	5,484	8,800	+3,316
Grand Total	$412,612B/	$375,684C/	$375,684	$330,900D/	$-44,784
Staffing Total FTE's	157	126	126	119	-7

Authorization: Sec. 31, P.L. 83-703, Sec. 309(a), P.L. 95-91, and P.L. 96-567

A/ The FY 1985 column does not reflect a reprogramming action of an additional $5,000,000 for the Loss-of-Fluid-Test (LOFT) program from prior year appropriation (from CRBR termination funds). The FY 1986 column reflects the amended request which reduced the program by $5,000,000.

B/ The FY 1985 funding is net of the following reductions: $-9,040,000 for General Reduction, $-3,792,000 for Small Business Innovative Research, $-7,705,000 for Management Initiatives, and $-2,200,000 for ADP Management Initiatives. The FY 1985 column does not reflect reprogramming, within Energy Supply R&D, of $1,580,000 for North Warning Project.

C/ Adjustments to the FY 1986 appropriations are described in the table following the nuclear overview table in the front of this section.

D/ The FY 1987 funding is net of a reduction of $1,950,000 for Management Initiatives.

DEPARTMENT OF ENERGY
FY 1987 CONGRESSIONAL BUDGET REQUEST
SUMMARY OF CHANGES
NUCLEAR ENERGY RESEARCH AND DEVELOPMENT
(In thousands of dollars)

FY 1986 Appropriation enacted	$375,684
Built-in increases and decreases	0
FY 1987 Base	$375,684
Program increases and decreases:	
Light Water Reactors	
o Reduced level of effort on severe accident technology	-1,509
o Refocusing of civilian reactor technology efforts to support industry/government program on development of advanced LWR's	+13,430
o Decrease in Three Mile Island R&D as program nears completion	-19,079
Advanced Reactor Research and Development	
o Shift Advanced Reactor R&D emphasis to support national security needs resulting in the following decreases:	
- High Temperature Gas-Cooled Reactor technology	-26,800
- Nuclear fuel cycle technology	-14,376
- Liquid metal reactor technology	-16,462
- Breeder reactor technology	-16,409
- Reactor development support	-5,003
Space and Defense Power Systems	
o Develop engineering design for advanced concepts, and conduct experimental and development efforts on multi-megawatt (MMW) power systems in support of the President's Strategic Defense Initiative (SDI)	+21,822
o Conduct preliminary design work on Multimegawatt Terrestrial Power Plant Project for the U.S. Air Force and the President's SDI	+3,000
o Increase for contractor design efforts, component development and testing, fuels and materials development/fabrication and testing, safety and design audits, and test facility preparation in support of Ground Engineering System (GES) development and testing of SP-100 space reactor technology flight readiness for SDI, non-SDI military, and civilian space mission applications in the 1990's and beyond	+14,019

o Planned reduction in support of the Small Nuclear Power Source Demonstration Reactor (SNPSDR) for long-term unattended military and civilian use in remote areas	-406
o Continue technology development of 1-10 KW(e) Dynamic Isotope Power System (DIPS) in support of the President's SDI	+13,000
Advanced Nuclear Systems	
o Increase design and development of isotopic power systems, nuclear facilities preparation, heat source development, and safety efforts in support of forthcoming civilian, military, and NASA programs	+3,776
o Increase radioisotope thermoelectric generator (RTG) design concepts and reliability testing for terrestrial applications	+334
Facilities	
o Decrease is due to redirection of facility efforts to primarily support space and defense energy requirements, and additional cost sharing provided by other programs to cover their use of facilities	-10,436
Water Cooled Breeder	
o Planned decrease in defueling and core evaluation efforts	-5,155
Program Direction	
o Increase necessary to cover total estimated FY 1987 costs; prior year carryover funds supplemented FY 1985 and FY 1986 requests........	+1,470
Total	$330,900

	FY 1986 Approp.	FY 1987 Request
Nuclear Energy Research and Development (R&D)		
Operating expenses	$357,019	$307,520
Capital equipment	13,181	14,580
Construction	5,484	8,800
Total	$375,684	$330,900

The Nuclear Energy (R&D) program develops, in cooperation with industry, advanced technology for improved powerplant safety and performance; conducts R&D on advanced reactor and radioisotope power systems for defense, space, and commercial applications; and operates R&D facilities that support all of the Nation's nuclear programs.

Nuclear power's applicability to a wide variety of uses is apparent from a look at the applications supported by the nuclear R&D budget. Technology developments to improve performance of current and future powerplants, special power sources to meet demanding temperature and reliability requirements of outer space, power sources to provide power at remote military and civilian locations, special power sources to meet unique requirements of the Strategic Defense Initiative (SDI), radioisotope power sources for terrestrial and space applications, and R&D on advanced reactor systems for commercial power application in the future are some of the activities in Nuclear Energy R&D.

Nuclear Energy R&D is conducted in within six activities: Light Water Reactors (LWR's), Advanced Reactor R&D, Space and Defense Power Systems, Advanced Nuclear Systems, Facilities, and Water Cooled Breeder. The objectives of each technical activity are summarized below; all the activities are described in detail in the narratives that follow.

From the experience accumulated to date on LWR research, development, design, construction, operation, and regulation, it is evident that major national benefits can be realized by advancements in each of these areas. Consistent with industry responsibilities, programs are already underway by the reactor manufacturers and the electric utility industry to exploit these opportunities on the existing generation of LWR's.

The demonstrated removal of the remaining technical, licensing, and institutional impediments to the design, construction, and operation of next generation LWR's is the overall objective that the complementary government/industry Advanced LWR (ALWR) programs address. A milestone in the pursuit of this objective will be the U.S. Nuclear Regulatory Commission (NRC) final design approval and certification of at least two ALWR systems in approximately 5 years. The pursuit of this objective will have the additional benefit of focusing and guiding the U.S. Department of Energy (DOE) efforts in nuclear licensing and institutional reform, safety research, component and system development and testing, and in licensing of advanced systems.

Advanced Reactor R&D is an activity that encompasses studies, tests, and experiments in reactor systems, core systems, and fuels and materials. This activity provides the knowledge base needed to support a continuum of civilian, defense, space, and terrestrial requirements with emphasis on near-term national security requirements, including the SDI. Remote, unattended operation, hardened sites, logistical independence from fuel supply lines, long-life fuels and systems, high acceleration pumps, and increased thermal heat removal are all necessary to meet the unique requirements of defense and space systems. An emphasis on meeting defense-oriented program needs will not affect the essence of the nuclear R&D program but will generate some new activities to address these unique requirements. Similarities are likely to exist among applications for military and civilian purposes, and efforts will be made to assure that fundamental R&D work will provide technology support for both civilian and military applications.

The reactor systems element will: determine the applicability of existing concepts to emerging military and SDI requirements, continue testing system features that meet both military and civilian requirements, and investigate advanced system control approaches. The core systems element includes: thermal hydraulic testing of advanced designs to demonstrate coolant circulation, in-reactor core and system response testing, modifying calculation codes to predict performance of new designs, and conducting tests on seismic response. The fuels and materials element will involve advanced fuels testing and fabrication and the development of high temperature cladding and structural materials for defense and high temperature applications in space and terrestrial systems. Work on the civilian advanced reactor program towards long-range applications will continue at a substantially reduced funding level.

The Space and Defense Power Systems activity is an integrated set of R&D activities that supports the national defense energy needs (i.e., both SDI and non-SDI military energy needs) and offers alternative energy supply sources to conventional fossil-based fuels. The activity has two main areas of emphasis: low power systems efforts (up to several hundred kilowatt electric (kWe)) and multimegawatt (MMW) power systems. The main elements of the low power systems are: SP-100 space reactor technology, the Dynamic Isotope Power System (DIPS) and the Small Nuclear Power System Demonstration Project (SNPSDP). The main elements of the MMW power systems are: the MMW Space Power System and the MMW Terrestrial Powerplant (MTP).

The Advanced Nuclear Systems activity develops, demonstrates, and delivers radioisotope power sources for military and civilian space and terrestrial missions. These isotope power supplies are fabricated and provided to Federal agencies to fulfill various applications that range up to 1 kWe. Two elements comprise the activity: the Radioisotope Thermoelectric Generator (RTG) program and special applications.

The Facilities activity provides the operational test environments essential for developing and verifying advancements in reactor systems, fuel, and power conversion equipment technologies for civilian as well as space and defense reactor applications. Such testing capability is critical to resolve the technical and cost uncertainties of these technology developments and confirm that the nuclear program mission objective to develop high performance, more reliable advanced reactors is being met. FY 1987 facilities activities will support civilian, space, and defense efforts. Test programs will also be conducted in support of international agreements, other DOE programs, and non-DOE programs on a cost-sharing basis. A new cost-sharing approach will be established for operating the test facilities that more equitably distributes costs among users and establishes an integrated DOE approach to facility utilization. This approach will be implemented to the extent practicable in FY 1987.

The Water Cooled Breeder activity will be completed in FY 1987, and it continues work associated with defueling the Shippingport reactor and core evaluation R&D to verify core performance and breeding characteristics.

	FY 1986 Approp.	FY 1987 Request
Light Water Reactors (LWR's)		
Operating expenses	$ 48,158	$ 41,000
Total	$ 48,158	$ 41,000

Maintaining a competitive U.S. technical capability and enhancing the safety, reliability, and cost performance of existing and new LWR's are important national needs. These needs can be met through cooperative and complementary actions by industry and Government:

- to improve the safety, reliability, and economics of the older generations of plants operating and under construction in the United States;
- to complete the development and acceptance of LWR designs able to be ordered for new or replacement capacity in the next 5 to 15 years;
- to explore innovative longer term reactor concepts with the potential for significantly reduced cost, investor risk, and enhanced safety for possible deployment after the year 2000.

The elements and FY 1987 funding levels of the LWR activity are: LWR Safety and Licensing ($11,000,000), Advanced LWR Technology ($18,000,000), and Three Mile Island (TMI) R&D ($12,000,000). The FY 1987 funding request is a $7,158,000 decrease from the FY 1986 appropriation. The requested level will permit a redirection of the activity to support a cooperative program with industry that will lead to final design approval and certification of advanced LWR's. This activity will support efforts to secure lasting improvements in the regulatory process, in part as a consequence of the removal of technical, licensing, and institutional impediments to the use of current and future LWR's.

Safety and Licensing (Operating expenses):

By 1987, more than 100 nuclear plants will be generating approximately 20 percent of the Nation's electricity. The use of nuclear power has substantially increased our energy security, by greatly reducing the dependence on imported oil in the United States, Europe, and Japan. A maximum of 14 additional units are scheduled to come into operation in the United States between 1987 and 1992. The U.S. regulatory system is generally regarded as a major barrier to the further utilization of this important energy option.

A major reason for this unnecessary limitation on LWR deployment is the Federal regulatory system, which many view as slow, cumbersome, and ineffective. The FY 1987 LWR activity reflects an increased emphasis on redefining the Federal Government's regulatory role and synchronizing this role with LWR technical R&D efforts. Efforts aimed at enabling the development and utilization of advanced systems will complement reform of the Federal regulatory system.

The central requirement in the Federal regulatory scheme is to assure the safety of nuclear powerplants. This consists of both a technical component as well as an understanding of economic impacts of the means used to regulate safety. The changing positions, policies, and regulations affecting the LWR industry have disconnected the technology from its value to end users. Clear and consistent policies affecting the technical basis for LWR construction and operation will provide the framework for a coherent regulatory policy at both the Federal and State levels. The technology is desirable and effective; but its availability as a future option is threatened. Industry must be able to meet the legitimate needs of regulators at the State and Federal level. However, the regulatory process itself must be rationalized to meet the needs of the next decade and beyond.

This element contains those tasks that support reform of the safety regulatory process, including where appropriate, participation in cooperative programs to facilitate the development and certification of improved systems for use in existing and future plants.

A critical task under this element is continuing the severe accident technology program. Fuel damage testing conducted during prior years, culminating in completion of the Loss-of-Fluid-Test program in FY 1986, provide the basis for evaluation of fuel damage tests. Sound technical analyses, including technical consensus on models and data for LWR's, will be the focus in FY 1987.

The goal is to develop and apply a severe accident methodology incorporating results of all recent experimental work and incorporating an understanding of the ability of operator actions to reduce the consequences of accidents through more informed decisionmaking in the control room. Effective consensus in this area is crucial to regulatory reform and a better understanding of the requirements for emergency preparedness at both the local and Federal level.

Concurrently, risk-based licensing techniques will be developed and coordinated with the NRC's August 8, 1985, policy on severe accidents. General agreement has been reached on the use of risk-based techniques, and application of such techniques to achieve improvements in the regulatory process is growing . What remains to be done is to apply these techniques in the consideration of design choices for future reactors. Procedures for considering alternative design features or alternative means of complying with safety standards will be developed and applied. Work in this area will provide increased confidence that advanced LWR designs meet all licensing and utility requirements for economic performance.

The third major effort in this element is a cooperative industry-Government program to extend the productivity of existing and future LWR's. The equivalent of 20 new LWR's could be realized through practical improvements in availability and lifetime of existing LWR's. Plant availability activities will be largely conducted through individual efforts at various operating plants or through more generic programs by the Electric Power Research Institute (EPRI) and industrial suppliers. However, the Department will sponsor selective studies to evaluate overall U.S. practices versus those of other countries and to participate in cooperative programs to enhance utilization of Government-owned facilities and laboratory expertise.

In FY 1987, we intend to concentrate on delineating which LWR key structures and components can continue in service beyond 40 years without replacement or refurbishment. Concurrently, the licensing requirements affecting this group will be examined. Those parts that would require replacement or substantial modification will be evaluated in terms of cost, affect on safety, and in the context of licensing. This effort could lead to not only a more rational Federal regulatory approach, but also provide a more informed basis for State regulatory evaluations of the economics and the safety impacts of investments in improved plant performance.

State regulatory bodies have continually urged utilities to adopt longer operating cycles between refueling shutdowns due to the economic penalty as well as the loss of baseload capacity to their systems. Efforts over the last 10 years on extended burnup have provided substantial benefits to the participating utilities. Consistent with the FY 1986 Congressional appropriation in this area, the Department has initiated a closeout of Federal involvement in this program. During FY 1986, Federal involvement will be completed in 9 of the 11 extended burnup projects. Now the focus is shifting to the state regulator to provide incentives to the utilities to continue this R&D. It should be noted that the incentive should reflect the reduction of spent fuel generated.

The shared and complementary responsibilities of State and Federal regulators provide many opportunities for intervention in large construction projects. Analyses will continue so as to identify these regulatory practices that would better balance the economic risks and benefits of investments in nuclear power projects while maximizing economic and other interests for the ratepayers and public at large.

Advanced LWR Technology (Operating expenses):

U.S. firms have participated in major programs in Japan to develop designs for Advanced LWR's. The U.S. electric utility industry has begun a smaller effort to draw upon the results of this program as part of an effort to enable the development of improved LWR's for the U.S. market. Until a more efficient and disciplined regulatory process has been proven, work on new safety systems and technologies will require some level of DOE support. A cooperative DOE-industry program has recently been initiated through a Memorandum of Agreement (MOA) with EPRI, at the request of the utilities, to assure that the lessons from U.S. past experiences have been successfully applied to these new designs. This effort, based on evolutionary advances in existing LWR technology, is directed at developing detailed requirements for future LWR's of the general size and type of advanced LWR's that U.S. vendors have been developing for sale both here and abroad. These modern designs represent R&D investments of several hundreds of millions of dollars. Further concept development is underway in selected areas where opportunities for substantial improvements in licensability and economic performance can be obtained through modest extension of current, proven technology.

The Advanced LWR element includes the development of innovative strategies for application of LWR technology. In the early 1970's, when the U.S. nuclear industry was thriving on high load growths, assumed economies of scale drove plant ratings from the intermediate range (400-800 megawatts electric (MWe)) to about 1000 MWe. The lower load growths projected today, combined with difficult utility financial situations, may indicate that plants with smaller ratings and lower total capital cost are needed if the U.S. nuclear option is to be preserved. This thinking has led some U.S. reactor manufacturers to develop small LWR concepts, which build on the extensive experience base but with innovative design features (based nonetheless on evolutionary advances into existing LWR technologies) that could contribute to increased margins, designs that are less sensitive to regulatory impact, and offer reduced construction periods and reduced total plant costs. Because of the relatively large resources needed to develop such designs and the uncertain potential for payoff, these concepts have been developed only to a very preliminary stage. Both the market and the regulatory process are too uncertain to justify the financial investment necessary to carry the design concepts to a stage at which their potential can be adequately assessed. Through the cooperative efforts of NRC, DOE, EPRI, utilities, and suppliers, the way can be paved to complete the development and acceptance of Advanced LWR's as an attractive energy option for the future.

In FY 1987, the following activities, supplemented by data from advanced converter reactor technology activities, will be pursued. Each of these will be closely coordinated with other system development programs conducted under the cooperative program with EPRI/industry:

- System design improvements to reduce the sensitivity of plant safety to transients, or to accommodate transients and off-normal events in a more passive manner, leading to reduction in the number of scrams and required operator or automatic control actions.
- Enhanced margins in existing reactor containments and other containment design improvements.
- Improved systems, components, and configurations to facilitate maintenance.
- Improved decay heat removal systems employing more passive design elements or functions, such as natural circulation cooling.
- Reduction of plant protection systems to failures in auxiliary systems to reduce the need for regulatory involvement or oversight.
- Costs and other implications associated with use of innovative construction techniques and the modularization or prefabrication of systems to achieve improvements in construction, operations, and plant life time.
- Development of new methods for combining manufacturing acceptance testing, site operational checkouts, and longer term operational monitoring so as to address a wide range of regulatory requirements in an assured and stable manner.
- Development of a technical/regulatory basis for improved control rooms, innovative LWR sensors to reduce challenges to plant protective systems, and increases in plant availability.

TMI R&D (Operating expenses):

The objectives of the TMI element are to develop the technology that will improve the capability of civilian nuclear powerplants to safely recover from accidents and to conduct relevant R&D that will substantially enhance nuclear powerplant safety and operation. There are two primary subelements within this activity, and these will be conducted in FY 1987: (1) TMI Waste Immobilization, primarily completed in FY 1985, and Reactor Evaluation and (2) Data Acquisition Program.

The TMI activities are implemented in accordance with a Memorandum of Understanding (MOU) signed by DOE, NRC, EPRI, and GPU Nuclear Corporation. The Department will obtain important R&D information that would not otherwise be available from the planned GPU TMI-2 cleanup effort. Responsibility for the costs of TMI cleanup remains with GPU, the owner of the facility.

Recent examinations and analyses have indicated that a substantial quantity (up to 20 tons) of core material is in the bottom of the reactor vessel, below the lower grid plate. The current GPU schedule projects the completion of fuel removal from the original core region by the end of FY 1986 and removal of the remaining fuel from the bottom of the reactor vessel and from primary system components by the end of FY 1987. Removal of fuel from the reactor vessel bottom is an unforeseen complication of the accident, as is the removal of the complex core support assembly that is also believed to contain a substantial quantity of relocated core material.

Beginning in FY 1986, the damaged core will be collected for shipment to a DOE laboratory for examination and interim storage. During FY 1987, DOE will terminate its onsite activities.

Data acquisition is a key element of the TMI R&D program. Specifically, DOE is funding R&D in terms of data gathering and analysis in the following major areas: instrumentation and electrical equipment performance; severe accident analyses, including the behavior of radioactive fission products (source term); data system and sample archiving; and offsite fuel debris examination. EPRI is providing mechanisms to assist in transferring this technology to industry.

Efforts in FY 1987 will be to conduct the offsite examination of the damaged TMI-2 reactor core at Idaho National Engineering Laboratory (INEL) and other laboratories and to transfer the technology to industry. The core examination will provide unique information on full-scale reactor-wide variations in fuel rod damage timing and mechanisms that include core degradation phenomena and related coolability issues; fission product release, deposition, and retention mechanisms; recriticality; and segregation of fuel and control rod materials during severe accidents. This work will provide the necessary data for evaluating present licensing criteria and requirements; developing future licensing criteria; and assessing and developing computer models that are necessary to analyze the course and consequences of severe accidents to mitigate the effects of such accidents. DOE's involvement in this effort will be completed in FY 1988. It is DOE's expectation that any additional R&D undertaken in connection with this program beyond FY 1988 would be the responsibility of GPU and industry.

Advanced Reactor R&D	FY 1986 Approp.	FY 1987 Request
Operating expenses	$123,432	$ 47,000
Capital equipment	5,118	2,500
Total	$128,550	$ 49,500

During FY 1987, Advanced Reactor R&D efforts will shift from focusing on civilian to focusing on military, space, and terrestrial energy needs. The efforts in FY 1987 will result in reductions from the FY 1986 base. These reductions are $43,262,000 for High Temperature Gas-Cooled Reactor (HTGR) technology, and Liquid Metal Reactor (LMR) technology, $16,409,000 for Breeder technology, $14,376,000 for Fuel Cycle technology, and $5,003,000 for Reduced Enrichment for Research and Test Reactors (RERTR).

Advanced reactor R&D will be reoriented to: phasing down commercial-specific designs and R&D while using existing technological advances to meet emerging and existing military terrestrial and space needs; maintaining an emphasis on civilian reactor applications where such needs overlap military needs; assuring the maintenance of a technological, testing, analytical, and design infrastructure to respond to the needs of the commercial sector as they materialize; and assuring a capability to spin off technological advances for utilization in a future advanced commercial reactor program. The activities envisioned for FY 1987 will preserve some important elements of the existing program, including some international activities while making the technological capability of the laboratories available for increased utilization toward space and defense applications.

A change of this nature, of course, will require a transition period. FY 1987 will serve as a transition time during which military needs will be identified, certain technological activities will be phased out, and the R&D emphasis will be shifted to provide the most efficient support of nuclear power needs. There is an existing data base in the country today on commercial and developmental power subsystems and components. However, these power subsystems and components were not developed for strategic defense application requirements, and thus the current configurations will not fully meet these requirements and/or may have adverse impacts on the overall systems. Further consideration needs to be given to many essential military technical issues, including duty cycle, effluent management, waste heat management, logistics, and survivability. It is anticipated that a transition as described will result in a program in FY 1988 that will be synergistic to the needs of military systems and civilian reactor systems.

Cooperative testing, design, and analytical programs on advanced reactors with the European nations and Japan will be continued, including private sector interactions, in the areas where the applications of results serve our prospective advanced commercial reactor needs Examples of cooperative programs utilizing unique U.S. testing capabilities and expertise are advanced fuel performance and optimized reactor shielding and core configurations. Cost-shared arrangements will be developed to enable the United States to remain knowledgeable and a part of the world move towards increased energy security through advanced reactor development, as well as maintaining a voice in the international nuclear nonproliferation regime.

Efforts within the Advanced Reactor R&D activity are based on the technology developed for HTGR, LMR, and breeder reactor concepts and are conducted under three primary elements: reactor systems, core systems, and fuels and materials.

Reactor Systems:

In FY 1986, based on the selection of a small modular HTGR concept, design of the reference HTGR candidate concept will be initiated to begin development of the level of design detail needed to support assessments of plant safety, reliability, operability, maintainability, modularization, constructibility, licensability, and economics. The HTGR data base is complemented by developmental data for very high temperature materials, which would be used in future HTGR process heat and/or defense applications.

Support technology development activities are focused during FY 1986 in the areas critical to the modular HTGR design assessment and licensing. Although priority will be placed on design and licensing activities, work will continue principally on development and qualification of fuels, graphite, and alloys for service in a modular HTGR. Plans are being developed and work initiated to verify fuel performance and fission product behavior to support the licensing basis for the modular HTGR design.

During FY 1986, emphasis within the LMR technology area is being placed on refining system concepts and plant arrangements by utilizing the preliminary concepts, plant requirements, and criteria developed during FY 1985. Studies and assessments are being conducted to enhance the objectives of cost competitiveness, improved safety and ease of licensing, plant reliability, marketability, and utilization of current technology. Technical analyses and evaluations emphasize constructibility, availability, safety, seismic response, thermal hydraulics, and system transients. Preliminary cost estimates, construction schedules, and R&D support requirements are being refined. The evaluation process includes independent reviews and assessments by national laboratories, utility organizations, and NRC in the form of preliminary licensing reviews and the generation of safety criteria. Technical support to the advanced concepts is being augmented by information gained from foreign exchange programs, including the DOE/Power Reactor and Nuclear Fuel Development Corporation (PNC) exchange on the MONJU reactor.

LMR technology activities in FY 1986 that are in support of the advanced designs include documentation of materials design data, including modified 9 Cr-1 Mo steel, technical support for inducer pump testing, flexible joint testing, and control studies for modular plant concepts. Feature tests in support of the advanced designs include heat transfer verification of the reactor auxiliary cooling concepts utilizing radiation cooling of extended surfaces and compact insulation development for a submersible electromagnetic pump. Also, model steam generator development will be pursued to support the requirement for improved performance predictability and reliability. R&D in support of other high risk components and features will also be pursued.

During FY 1987, the commercial advanced converter conceptual evaluations will be phased down and redirected to determine the applicability of existing concepts to emerging military/space needs. Design lessons learned will be applied where applicable to existing DOE SDI programs. R&D specific to military needs will be identified and conveyed to the technologists for R&D planning uses. Only crucial key features tests will be conducted as part of the orderly closeout of civilian reactor-unique hardware testing. Testing programs of features that have application both to military and civilian reactor requirements will be identified, and such testing will be continued. Planning for the conduct of military-specific tests will be initiated. New plant control schemes as necessary to meet military environments will be identified, and R&D will be conducted to support those needs, and civilian reactor program needs, where they overlap.

Emphasis in the international program will be directed toward improving and enhancing interactions between the United States and Japan as well as Europe. The program will be designed to maintain a minimal viable capability with U.S. vendors in commercial plant design, especially retaining, to the degree possible, the U.S. capability to deploy advanced converters and breeder reactors as the need arises.

Other FY 1986 efforts include the RERTR project to develop a low-enriched uranium (LEU) (LEU-20 percent U-235) fuel for foreign research and test reactors now using highly-enriched uranium fuels. The objective of this project is to demonstrate performance and commercial fabrication capability for alternate LEU fuel systems for the conversion, licensing, and use of the LEU fuels with minimum impact on economics or testing capability for the reactor owners/operators. In FY 1986, full core demonstration activities of an LEU-silicide fuel system will be conducted in the Oak Ridge Research Reactor. Proven performance of this fuel will allow conversion of most of the so-called high performance reactors that are the large consumers of highly enriched uranium fuel. Prime focus of the program in FY 1986 will move from technology development to actual conversion of the reactors, which falls under the responsibility of the Department of State or the Arms Control and Disarmament Agency. Therefore, no funds are requested by DOE for this effort in FY 1987 on the basis that the necessary funding should be requested by the other agencies.

Core Systems:

The disciplines of safety, physics, structures, thermal hydraulics, and reactor core design are integrated into a single cohesive effort to investigate key design options for reducing plant complexity, costs, and investment risks and for improving reactor licensability and public confidence. The efforts focus on demonstrating analytically and experimentally the capability of advanced LMR concepts of varied design, size, and fuel type to self-terminate the nuclear reaction process and to protect the reactor core from damage under a variety of conditions.

Accident prevention, e.g., development of concepts and technology that utilize natural phenomena to preclude core disruption, is a key consideration in the thrust of the R&D. Studies on how best to use the positive attributes of sodium coolant to remove decay heat are included. Varied fuel configurations and fuel pin sizes are evaluated, as well as the effects of varied core designs on voiding, temperature, and reactivity coefficients. Efforts to develop an advanced shutdown heat removal capability include feature tests of the most promising concepts for achieving passive, reliable heat removal independent of the main heat transport system. High margin safety/core design activities include investigating core design and analysis (thermal-hydraulic and neutronic) of alternate configurations that show the potential for achieving assured safe shutdown without immediate operator action.

Efforts during FY 1986 include technical support for natural circulation tests to prove the inherent capability of LMR's to respond safely to situations involving loss of forced circulation flow without scram. Results of transient tests are being analyzed to establish safety margins for advanced fuels used in the advanced LMR designs. Benchmark measurements and shielding analyses are being initiated at the Oak Ridge National Laboratory (ORNL) to support cost reductions for the General Electric Company and Rockwell International Corporation advanced designs. A reactor seismic code is being completed that factors in duct test results obtained from DOE and Japanese experiments. In-depth analyses are being conducted for advanced core designs and of alternative heat removal system concepts. The program to demonstrate promising applications of advanced computerized technology to plant construction and operation is being continued. These efforts are closely coupled with continuing efforts to identify new plant control system concepts that will reduce overall plant complexity and improve operational safety of existing DOE facilities as well as the advanced LMR designs.

Other FY 1986 activities include: safety analyses to support the Core Demonstration Experiment (CDE), including safety analyses and evaluation of long-life fuel pin cladding material under transient conditions; run-beyond-cladding breach and transient overpower testing of oxide fuel and blanket pins in the Experimental Breeder Reactor II (EBR-II) under a collaborative U.S./PNC-Japan program; transient tests of high burnup fuel pins from the United Kingdom for computer code validation under the Prototype Fast Reactor/Transient Reactor Test Facility (TREAT) agreement; continuation of a shared cost cooperative Computerized Reliability Data Bank data collection program; and a systematic study with PNC of reactivity feedback effects and core design options that can be used to assure high safety margins in advanced LMR's.

Planned activities for FY 1987 include thermal hydraulic testing to support both military and civilian needs. This work will be brought to a close when sufficient information has been developed to establish the case for passive decay heat removal capability. Such results will be combined with in-reactor inherent safety core and system response testing. When available, military needs will receive greater emphasis in establishing test programs. It is anticipated that military needs will differ primarily in the requirements for fast moving control rod systems, high acceleration pumping capability, increased thermal heat removal requirements, protected heat sinks, hardening of control systems, and certain other structures against environments anticipated during military engagement situations. Fast ramp control schemes will be identified, and their effect on core kinetic response and heat removal capability will be investigated. Instrumentation and control system will be developed that have a fast response capability and that are hardened to survive harsh environments. Tests and analyses will be conducted to show the ability to withstand seismic and other high-shock loadings. Existing calculational codes will be modified to reflect the above testing data and emerging military needs.

Fuels and Materials:

The primary focus of fuels and materials activities is to verify required service lifetimes of core components. To accomplish this, component tests are performed under prototypic operating conditions to exposure levels equal to and exceeding their anticipated service lifetimes. Subsequent examination and analysis of these prototypes ensure the reliability and licensability of similar components intended for power-producing applications.

During FY 1986, fabrication of the 23 long-life core assemblies is being completed utilizing advanced cladding and duct material to support the CDE. Sixteen of these assemblies are being placed into the Fast Test Reactor to begin an irradiation test program that will demonstrate a threefold or greater increase in core life and a corresponding reduction in reprocessing requirements.

Nuclear Fuel Cycle activities in FY 1986 focus on smaller, remotely operated and maintained reprocessing equipment and systems that have the potential for providing economic throughputs in smaller facilities and enable corresponding reductions in plant size and capital costs. The technical program was established to develop the basis to reduce radiation exposure to workers, increase environmental protection, increase reliability, enhance both domestic and international safeguards, and reduce operating costs.

The fuels and materials activities in FY 1987 will place emphasis on the identification of the limits of performance of fuels in military and space missions and, in particular, those missions needing burst-type operations. In addition, R&D will also be conducted in high temperature and high strength cladding and structural materials for defense applications as well as for space and certain civilian applications. Nuclear Fuel Cycle activities will be phased down and redirected towards application of remote systems technology in support of civilian, space, and defense energy needs and towards fostering further international fuel cycle collaboration.

(Capital equipment):

The requested funding will provide for the procurement of special test hardware, such as thermocouples, pressure transducers, and instrumentation that are necessary to conduct planned experiments. In addition, the funding will provide for fabrication of test articles for TREAT transient tests, laboratory support equipment, and data acquisition equipment for safety tests.

	FY 1986 Approp.	FY 1987 Request
Space and Defense Power Systems		
Operating Expenses	$ 16,367	$ 60,370
Capital Equipment	1,924	6,280
Construction	1,924	5,000
Total	$ 20,215	$ 71,650

The Space and Defense Power Systems activity provides the design, development, and supporting technology for compact, high performance nuclear power systems for space and terrestrial defense and civilian applications. Although efforts are focused primarily at SDI and other military applications in the near term, the developed systems will have applicability for future space and terrestrial commercial systems.

The activity has two main areas of emphasis: low power systems and MMW power systems.

The low power systems area and associated FY 1987 funding include the several hundred kWe SP-100 reactor system at $30,000,000 and the 1-10 kWe dynamic isotope power system at $13,000,000 for space applications, and a 15 kWe reactor at $2,000,000 for remote terrestrial applications.

The MMW power systems area also involves space and terrestrial defense applications that are funded in FY 1987 at $23,650,000 and $3,000,000 respectively. The space effort involves a MMW space reactor technology that can provide several megawatts of continuous power and hundreds of megawatts of burst power in support of the SDI. The primary focus of the terrestrial effort involves the design and construction of a 10-MWe minimally attended reactor plant that could provide secure power for military logistic centers, U.S. Air Force (USAF) installations, and ground-based components of the SDI.

Both the space and terrestrial defense efforts build on existing technology developed in the civilian reactor program. However, the space efforts will require extension of the technologies into higher temperature regions and more exotic materials in order to meet the stringent weight and size constraints of the space systems. In all of the applications, the nuclear power systems offer distinct advantages that, for many missions, cannot be satisfied with other power systems.

Low Power Systems

A major effort to satisfy low power needs is the SP-100 Space Reactor Ground Engineering System, as part of a triagency program in support of both SDI and non-SDI military missions and future civilian missions. Another focus is on the development of a 15-kWe unattended terrestrial reactor as a potential alternate power source for the military's short-range radar sites in the modernization of the Distant Early Warning (DEW) line across Northern Canada. The third effort in the low power systems area is the Dynamic Isotope Power System (DIPS) under joint development by the U.S. Department of Defense (DOD) and DOE to meet power requirements in the 1-10-kWe range for military spacecraft.

SP-100 Ground Engineering System (GES) (Operating expenses):

In 1983, the DOE, the National Aeronautics and Space Administration (NASA), and the Defense Advanced Research Projects Agency (DARPA) entered into a MOA to jointly investigate, develop, and fund Space Reactor Power System Technology in the hundreds of kWe power class (up to approximately 1000 kWe). The DARPA role was subsequently transferred to the Strategic Defense Initiative Organization (SDIO) within DOD. The initial objective of this triagency program was to establish the technical and safety feasibility of and advance the technology related to safe, compact, light weight, and durable high performance space nuclear reactor power systems of several hundred kilowatts. With the successful achievement of this initial program objective during FY 1985, the next objective is to develop and demonstrate this enabling technology so that it will be available to a broad class of emerging military and civil space applications in the early to mid-1990's and beyond.

Because of the need for a space power system on the order of several hundred kWe in the relatively near term for both military and civilian applications, the focus has been on reactor power system technology that could satisfy on-board space electrical power requirements in the range of hundreds of kilowatts up to approximately a megawatt. Potential military applications span the entire spectrum of SDI and non-SDI military space needs, including survivable communications; surveillance, acquisition, tracking, and discrimination; electronic countermeasures; propulsion, orbital transfer, and stationkeeping; and a variety of other applications, such as weapons platform quiescent power and cryogenic cooling, assembly and maintenance staging platform power, etc., as well as classified mission applications. Potential civilian applications of the technology include the NASA growth space station, propulsion, orbital transfer, and stationkeeping; communications; navigation; and experiment instrument systems for future planetary and lunar missions.

As an integral part of the triagency Space Reactor Power System Technology program, missions analysis, requirements definition, and user interfaces have been investigated. These efforts are now beginning to bear fruit. The using community is now keenly aware of the program and the advantages that a nuclear power system can offer. In particular, the USAF has generated a Statement of Operational Need for compact space power. In general, the using community now recognizes: the critical need for improved space power systems; nuclear power as an enabling technology; the obvious potential of nuclear systems; that power system technology development must proceed; and the need for power system demonstration--all so that power system availability for dedicated use will match projected mission launch dates. In addition, positive steps within the using community have been initiated to assess reactor power system technology and to complete the necessary planning for the established SP-100 reference mission so that firm dedicated mission commitments can be made for the technology. A planned 300-kWe SP-100 nuclear electric propulsion flight demonstration for SDIO in FY 1993 was established in September 1985. This reference mission will serve to demonstrate and flight qualify SP-100 for follow-on dedicated mission use. Preliminary reference mission planning will be completed in mid-1986. Funding for this planned flight demonstration has been programmed by the SDIO in their outyear budget projections starting with FY 1987.

The overall SP-100 project is comprised of three phases as follows:

- Phase I: the Technology Assessment and Advancement Phase (1983-1985), which included conceptual design studies and assessment of technical and safety feasibility,
- Phase II: the Technology Flight Readiness Phase (1986-1991), which involves design, engineering development, and ground demonstration testing of a selected system concept, and

- Phase III: the Flight System Production, Qualification, and Demonstration/Application Phase (approximately 1991-1993), which involves flight unit production and qualification, payload integration, launch vehicle mating and launch support, launch, and actual operation of the system in space.

Phase I resulted in the successful establishment of concept technical and safety feasibility as well as downselection to one system concept. Concept selection of an out-of-pile reactor thermoelectric system and the selection of a 300 kWe power level for ground demonstration testing during Phase II were both made in early August 1985. In addition, the Hanford Engineering Development Laboratory (HEDL) in the state of Washington was selected as the preferred site from among five existing candidate DOE sites for GES testing during Phase II. This will allow the engineering development and ground test program to start as planned in FY 1986. The management issues associated with the Phase II efforts have also been resolved and an updated MOA among the several participating agencies was signed in October 1985. Under this agreement, DOE has the responsibility to carry out the GES development and testing portion of the overall triagency SP-100 Phase II Program.

The FY 1987 request and outyear estimates are targeted toward completion of the GES development and testing effort by 1991. The objective of this effort is to develop a manufacturing base and obtain component, subsystem, and system performance, safety, lifetime capability, and engineering data sufficient to demonstrate technology flight readiness and support a flight program. A competitive solicitation has been undertaken to select the system development contractor for the GES effort by issuance of a Request for Proposals in November 1985. This solicitation is expected to culminate with placement of a contract by late-summer 1986. The detailed design for the selected system concept (reactor/thermoelectrics) can then proceed. Specifically, in FY 1987, the preliminary reference flight system design at the component level will be completed and major progress will be made on the GES design. Procurement of long-leadtime materials, primarily refractory metals, can also be initiated, as well as the continuation of safety analysis, design audit, and power system/technology scaling studies. Detailed design of many of the components will be completed, and component fabrication and testing will be undertaken on items, such as the liquid metal pumps, heat exchanger, reactor shield, power conversion subsystem, heat pipes, etc. Major effort will also continue on the required environmental and safety documentation for the ground test. These efforts will continue through FY 1987 and will constitute the major focus of the program in that year.

Supporting technology efforts will also continue during FY 1987 to expand the data base of the reactor/thermoelectric system concept and will be used to broaden the data base required to assure that the technology can be successfully demonstrated during the GES effort. Such required technology efforts include continued work on the selected reference fuels technology and fabrication, fuel and cladding compatibility tests, fuel and cladding irradiation tests on the selected fuel/cladding combination, and power conversion, thermal transport, and heat rejection component design, piece part procurement, fabrication, and test.

(Capital equipment):

The GES test effort will require modifications to the selected test site facility, including specialized equipment to support the test program. This equipment will include test consoles, instrumentation panels, sophisticated monitoring equipment, vacuum chambers, pumps, etc.

(Construction):

A decision was made in November 1985 to use the Plutonium Recycle Test Reactor containment facility at HEDL as the preferred site for the GES testing. Substantial modifications will be required at this facility, and the required architecture and engineering design work will have been initiated in FY 1986. FY 1987 funds will result in the completion of most of the design work, receipt of long-leadtime procurement items, and initiation of actual facility modifications.

Small Nuclear Power Source Demonstration Project (SNPSDP) (Operating expenses):

The USAF has identified a need for power systems that can operate continuously in a remote, unattended or minimally attended mode with high reliability, low maintenance, long lifetime, and simplified logistics. Nuclear reactor technology appears to provide feasible and improved alternatives to conventional power systems, such as diesel generators. As a result, a cooperatively funded project is underway to assess and develop a nuclear power source for this application and for possible civilian uses as well.

The SNPSDP involves the design, development, and testing of an unattended 15 kWe reactor for use in remote applications, such as the North Warning Project (NWP), the planned upgrade of the DEW line across Northern Canada. The NWP is currently planning to use diesel systems as the power supply, but if a reactor alternative can be satisfactorily demonstrated, it could provide significant potential advantages in overall life-cycle costs and logistics operations. The goal is to place a demonstration reactor on test by early FY 1987 and to have a prototype unit installed approximately a year later. Upgrades of this technology could also have significant potential in civilian applications in cold, remote regions of the far north.

The project is a joint effort between Atomic Energy of Canada Limited and DOE with support from both the Canadian Department of National Defense and the USAF. Development costs are being shared by the four organizations with the overall U.S. and Canadian contributions to be roughly equal. Within the U.S. share, the USAF provided $1,500,000 in FY 1985 and is expected to provide another $1,500,000 in FY 1986 and $1,000,000 in FY 1987.

In FY 1985, a reactor conceptual design and cost trade-off studies were completed that indicated the nuclear reactor concept was highly competitive with diesel generators. A decision was made to proceed with the development of a demonstration reactor, and funds were reprogrammed in FY 1985 from other Nuclear Energy programs to continue this effort. Also in FY 1985, the reactor design was initiated, and long-lead procurement orders were placed. In FY 1986, the design is being completed, component development testing is underway, and the demonstration reactor is being fabricated.

In FY 1987, all components for the demonstration reactor will be fabricated, including the particle fuel, graphite core, heat pipes, reflector, control rods and drive mechanisms, and the Organic Rankine cycle power conversion system. Zero power tests will be conducted at the Los Alamos National Laboratory (LANL) on the core-fuel-reflector-control rod-heat pipe subassembly to verify the neutronics performance. This subassembly will be transported to the Whiteshell Nuclear Research Establishment in Canada and integrated with the power conversion system. The assembled reactor will be installed in a test cell at Whiteshell, and after checkout, a series of system startup tests will be initiated in early FY 1988.

(Capital equipment):

Funding is requested to cover purchase of reactor control computer, peripherals, and reactor instrumentation.

Dynamic Isotope Power System (DIPS) (Operating expenses):

The DIPS is being developed under joint DOD and DOE sponsorship with cost-sharing to meet power requirements in the 1-10-kWe range for military spacecraft. DIPS may well be the only viable power source in this range for spacecraft that requires survival and maneuvering capabilities. Therefore, without this power source, certain space missions will not be feasible.

Based upon studies by four DOD contractors, DIPS may be the enabling technology required for the Boost Surveillance and Tracking System (BSTS) and the Space Surveillance and Tracking System, which have planned launch dates in the early 1990's as part of the SDI. These space surveillance satellites will require (1) large amounts of power (1 to 10 kilowatts), (2) compact size, and (3) survivability against threats, such as nuclear and laser attacks. DIPS will provide the necessary high power and compact size to enable these spacecraft to perform their missions.

To provide such a reliable high power source, the Department is pursuing, in cooperation with DOD, the technology development of a turbine-alternator conversion system. This dynamic conversion system, when coupled with a radioisotope heat source, offers the potential of high power levels at high efficiencies. Under DIPS, design and technology studies will be carried out focusing on the military's requirements. To meet the criteria of high reliability and long life will require a high degree of quality engineering and quality control within the development program.

Planned efforts for DIPS in FY 1987, which is being initiated in FY 1986 with USAF funding, are to complete the conceptual design studies and survivability analyses for the two dynamic conversion conceptual approaches, i.e., Organic Rankine and Brayton cycles. Also in FY 1987, component development and testing will begin on critical subsystem assemblies. Power subsystem design and spacecraft preliminary interface requirements will be defined for the potential SDI missions. Selection of the DIPS conversion cycle will be made. Preliminary designs for the engineering unit will be initiated, and life testing of the critical components of the selected conversion cycle will be continued. Safety and operational analyses will be initiated. The FY 1987 funding request is generally consistent with the current interagency understanding on a cost-sharing arrangement between DOE and DOD/USAF. The funding is also consistent with the FY 1986 Congressional guidance that the Department pursue research and development activities associated with a nuclear isotope dynamic conversion power system.

(Capital equipment):

Ground demonstration unit equipment for both the Organic Rankine and Brayton Systems will be procured and installed in order to make a conversion system selection.

Multimegawatt (MMW) Power Systems

The MMW Power Systems efforts are directed toward the development of nuclear power systems in the megawatts to hundreds of megawatts power range. These efforts include the development of high performance reactor concepts and technologies to meet the SDI's continuous (several megawatts) and burst (hundreds of megawatts) space power requirements; the design, fabrication, and construction of a minimally attended 10-MWe terrestrial reactor to provide secure power for military logistic centers and USAF installations; and studies of related high performance terrestrial reactor systems to meet SDI power requirements.

MMW Space Power System (Operating expenses):

The MMW Space Power System element is the nuclear component of the joint DOE and SDIO program to develop large power sources, both nuclear and nonnuclear, for space applications. The goal is to identify and develop high performance reactor concepts and technologies that meet SDI space prime power requirements and to select at least one concept for engineering development and ground testing starting in early FY 1992. This concept may also satisfy future NASA civilian missions requirements for megawatts of electrical power.

The SDI initiative proposed by the President is dependent upon having a viable energy source to power the defensive Directed and Kinetic Energy weapons and to operate the overall integrated system, including tracking, surveillance, and communications. The power needs vary from a few megawatts of steady-state power for the system operation functions to hundreds of megawatts of burst power for the weapons systems.

In making decisions on which MMW systems will meet SDI needs, the total integrated energy requirement (power level multiplied by duration) may be of more significance than the power level itself. These power and integrated energy levels are orders of magnitude greater than can be met by current SP-100 or similar technologies without excessive weight, volume, and cost. These increases will be accomplished, to a large extent, by increasing the system operating temperature and reactor power density and by simultaneously developing advanced, highly efficient, light weight conversion and heat rejection systems that are up to orders-of-magnitude lower in specific weight (kilograms per kilowatt) as compared to SP-100. Therefore, advanced space power, such as the MMW system, must be developed as an enabling technology for the success of the SDI.

In cooperation with the SDIO, DOE has embarked on a jointly funded program to develop space reactor technology in the MMW regime. SDIO provides funding to DOE to assess various reactor power system concepts and to develop the nonreactor technology portions of the overall reactor power systems. DOE funding will provide for the R&D of the nuclear reactor and directly related nuclear technologies.

During FY 1985 and FY 1986, using SDIO funds, the focus has been placed on assessing and investigating various system concepts and related critical technology areas that must be advanced if these reactor system concepts are to be able to meet the power, mass, volume, and longevity requirements of the SDIO. Simultaneously, SDIO will be carrying out similar analyses on nonnuclear concepts. Out of this process, a total of perhaps five or six candidate concepts (including three or four nuclear concepts) will be selected for further development.

The FY 1987 effort will continue the evaluation and development of potential concepts primarily using SDIO funds. The DOE funds will allow the experimental testing and development of key enabling technologies that are required if the preferred concepts are to become fully viable. These experimental testing and development efforts will focus on advanced nuclear fuels, materials, safety, and reliability. Advanced reactor control techniques and neutronics, shielding, and thermal hydraulic codes will also be developed.

Higher reactor operating temperatures and higher heat rejection temperatures can significantly lower overall MMW power system mass and size. However, increasing the reactor temperature imposes stringent demands on reactor fuels and materials. The requirement for advances in fuel technology is the result of a need to operate the reactor at a much higher power density, higher burnups, increased longevity, and at unusually high thermal stress conditions over the fuels of today's technology. For these reasons, extensive testing both in-reactor and out-of-reactor must be performed. Lead times of a minimum of 1 to 2 years are needed to develop the fuel and cladding material to the required specifications, and at least 1 year of irradiation is needed to obtain useful information on fuel performance. Therefore, it is imperative that a significant effort be devoted to fuels and materials in FY 1987 to meet the concept downselection milestones as well as the final 1991 concept selection milestone.

To provide the low mass, high-temperature materials that are compatible with liquid metal and/or gas coolants, the MMW effort must include the evaluation of a full range of alloys, high temperature advanced composite materials, and structural ceramics and coatings. Coincident with this effort will be the evaluation of alternative materials to be used as radiation shielding. As a significant fraction of the power system weight, shielding material, such as tungsten, lithium hydride, or borated beryllium oxide, must be evaluated in terms of coolant compatibility and weight-optimized design.

Candidate fuels such as cermets, stabilized uranium nitrides, thermionic, aerosol, and coated-particle fuels will be analyzed as to their respective capabilities to withstand the order-of-magnitude increase in required performance. In addition to fuels and materials, calculational methods on advanced neutronics and safety, physics, thermal hydraulics, and core design will be developed as early as possible to adequately evaluate and reduce the number of proposed concepts. This will allow the maximum use of resources and time to be devoted to the most promising concepts. If the fuels and materials and other technology development efforts are not adequately addressed in FY 1987, the result could be an extension of the program beyond 1991, thereby jeopardizing DOE's ability to provide SDI with a proven concept for engineering development and ground testing on schedule.

A thermionic fuel element verification program will also be conducted to address the key technical issues raised in the SP-100 concept selection process, reoriented to the MMW regime. MMW class thermionic fuel elements, components, and materials will be fabricated and tested out-of-core as well as in-core. This includes advanced thermionic fuel, ceramic sheath insulators, cesium-graphite reservoirs, and insulator seals.

The surety requirements for the MMW concepts will be thoroughly analyzed to ensure that operation of the power system will be highly reliable and causes no adverse effects on other components involved with the mission, the operating personnel, the health and safety of the public, or the quality of the earth's environment. This aspect must be considered at the earliest possible time and will require the identification of an initial set of surety design issues from which preliminary concept guidelines can be based.

(Capital equipment):

Capital equipment funding will be used for the acquisition of instrumentation and equipment to support proceeding with the MMW space reactor technology development efforts. This includes items such as: instrumentation required for in-reactor and out-of-reactor testing of advanced space reactor materials and components, fuels fabrication and processing equipment, high vacuum chambers, vacuum furnaces, helical induction pumps, compressors, furnaces, and valving.

Multimegawatt Terrestrial Powerplant (MTP) Project (Operating expenses):

The second major effort is the continuation of studies and designs leading to possible construction of nuclear powerplants to satisfy a requirement for secure and reliable power to ground-based components of the SDI and to other military installations. For these applications, uninterrupted availability of electrical power is critical to the performance of specific missions. Such power systems, because of their modularity, could also be used in the civilian/commercial sector.

The SDIO has expressed interest in a nuclear powerplant for its ground-based assets. These assets include the command, control, and communications systems that must operate reliably in a hostile environment if the total SDI system is to be credible. Also included are electromagnetic guns for terminal defense, surface to space directed energy weapons, radars, and facilities for placing surveillance satellites into special orbits. The source of power for these assets must be relatively invulnerable to terrorism, sabotage, and electromagnetic pulses from high altitude nuclear detonations as well as to acts of nature, such as lightning strikes, snow, windstorms, etc. As the SDI system emerges, it is possible that a significant portion of the detection and weapon systems will be ground-based rather than space-based; these assets will need power supplied from a dedicated, secure, and reliable powerplant.

Conceptual designs for a nominal 10-MWe nuclear powerplant capable of providing a secure, hardened energy supply at military installations have been prepared and were found to meet DOD requirements. All were judged to be well within the capability of U.S. industry to develop and produce. The technical, cost, and schedules risks were judged to be minimal, and in FY 1986, up to two designs are being selected for detailed design work. It is planned to select one design for fabrication and construction when the detailed design is completed. The designs include features that enhance passive safety, permit small sized operating crews, offer capacity factors of greater than 90 percent, and make the plant relatively invulnerable to certain specified military threats. The plant will be largely factory fabricated, thus minimizing costly field fabrication and erection.

The funds requested in FY 1987 will complement funds provided by DOD and will support preliminary design work (Title I - Engineering Services) on the concepts being selected in FY 1986, along with any studies deemed necessary on larger plant designs or advanced reactors. Specific activities to be conducted include the completion of topographical and site surveys for a 10-MWe plant, development of a work breakdown structure and project schedule, the preparation of a preliminary cost estimate, and the preparation of a Preliminary Safety Analysis Report. Based on the results of this work and follow on detailed design work (Title II - Engineering Services) to be accomplished in FY 1988, it will be possible to select a concept for construction on a schedule to meet SDI and other requirements.

	FY 1986 Approp.	FY 1987 Request
Advanced Nuclear Systems		
Operating expenses	$ 17,854	$ 20,600
Capital equipment	1,636	3,000
Total	$ 19,490	$ 23,600

The Advanced Nuclear Systems activity is charged with the responsibility for the development, demonstration, and delivery of radioisotope power sources for U.S. military and civilian space and terrestrial missions, and for the assessment and maintenance of these energy sources consistent with the Department's health and safety, safeguards, and security requirements. The FY 1987 requested funding level is an increase of $4,110,000 from the FY 1986 appropriation. This increase is primarily a result of existing or planned military requests for the DOE to develop the isotope power system technology to support national defense and security programs of the United States.

The Advanced Nuclear Systems activity is comprised of two major elements: (1) Radioisotope Thermoelectric Generators (RTG's) and (2) Special Applications. The goals of this activity are to support civilian and military specialized applications through the development of a range of isotope power system options and to assemble, test, and deliver these isotope power systems for approved mission applications. The activity is oriented to meet the specific product requirements of user agencies. This product orientation is accomplished through support for isotope power system development and isotope power system production as requested by the these agencies. In order to meet requests from user agencies, the Department conducts a balanced, goal-oriented R&D program and maintains the necessary isotope power production facilities in a state of readiness. The Department also provides for the important safety, reliability, and quality assurance functions that enable it to discharge its statutory responsibilities.

The RTG efforts provide the system design, integration, and converter fabrication for U.S. space missions and provides the facilities and technology to build and test the various isotope power systems for Federal user agencies. This activity includes the required technical, safety, safeguards, and security support for the nuclear activities. The Special Applications element includes the advanced R&D for terrestrial isotope power supplies requested by the military. The two elements are closely connected. Under RTG, the systems contractor will design the isotope power supply to meet the specific space mission requirements and will fabricate the conversion systems. The DOE laboratories will fabricate the isotope heat source for the isotope power supply and perform the final assembly and testing. The supporting safety and technology work is concurrently carried out under this element. The RTG element also provides the RTG and heat source assembly and safety support to the Special Applications activity. A similar arrangement exists between the DIPS and RTG elements for isotope-powered dynamic conversion systems.

A major effort under RTG has been the design and fabrication of the isotope power supplies and planning of launch support activities for the NASA Galileo and Ulysses spacecraft, which are scheduled for launch aboard space shuttles in 1986. These isotope power supplies include 4 flight RTG's and 110 radioisotope heater units to provide thermal energy to various systems. These two important national and international space missions would not be possible without isotope power systems.

Following the 1986 launches of the Galileo and Ulysses spacecraft, the Department will analyze the performance of the General Purpose Heat Source (GPHS) RTG's on these two spacecraft and provide power predictions to enable NASA to successfully carry out these missions. In parallel, the qualification and engineering units will be kept on test at the Mound Plant to determine the long-term performance of the GPHS-RTG design.

With the completion of the GPHS-RTG's for the Galileo and Ulysses missions, it is essential that continued improvements be made in the design margin of the GPHS for future shuttle-launched spacecraft. This design improvement work will involve extensive interactions among the several safety organizations to address the various safety and design criteria within the overall power system constraints. This design improvement will build upon the extensive safety tests and analyses carried out in FY 1985 and FY 1986 in support of the Galileo and Ulysses launches.

In preparation for future NASA and DOD space mission, the Department is also pursuing an advanced RTG design that offers higher power per pound and greater versatility. This program, known as the Modular Isotope Thermoelectric Generator (MITG), will enable NASA to accommodate a range of interplanetary missions identified by the Solar System Exploration Committee of the NASA Advisory Council. The MITG is also a candidate power source for the flight experiment of the BSTS for the SDI program.

In support of the Special Applications element, the Mound Plant will develop the facilities, tooling, and procedural capability to fuel, assemble, and test terrestrial RTG's for national security applications that are expected to be in the power range from a few watts to 180 watts (electrical). A current requirement exists to deliver a 180-watt RTG in late 1988. Also, the Mound Plant and LANL will begin development of a heat source for a new class of low wattage RTG's for national defense missions. The fuel for these RTG's will come from the Savannah River Plant, and the actual nuclear heat source assembly for these low wattage RTG's will be carried out at LANL.

ORNL will provide the materials technology support for the new space and terrestrial RTG's by characterizing and/or improving RTG heat source materials. The Savannah River Plant will continue in a production-readiness mode for the fuel form production and encapsulation activities that are now scheduled to begin in FY 1989 in support of future space missions. All of the heat source laboratories will provide design and fabrication support to the DIPS program.

Radioisotope Thermoelectric Generators (RTG's) (Operating expenses):

Efforts within this element are directed at providing the flight RTG designs, system integration, and flight converter fabrication, as well as advanced RTG designs, for space missions. Other efforts include the nuclear facility operations, safety testing, analysis, work and the required independent technical, safety, reliability, and quality assurance support to enable the Department to meet its statutory responsibilities. Also included are all of the system design, system safety, and flight converters for the planned 1986 launches of the Galileo and Ulysses spacecraft and the continuing flight support efforts of life testing, power predictions, and performance analyses. Also, efforts related to the development of the advanced MITG are conducted to meet the requirements of planned civilian and military missions.

In FY 1986, flight acceptance testing of all flight units and the submittal of all software items are being completed. Government acceptance of all four flight GPHS-RTG's for the Galileo and Ulysses missions is also being completed, and the RTG's are being shipped to the Kennedy Space Center (KSC). The spare flight GPHS-RTG will be returned to the Mound Plant for protective storage. In parallel and in support of the flight systems development activities, the Mound Plant is continuing the life testing of the qualification and engineering units of the GPHS-RTG. This testing will continue in FY 1987 to enable making the required performance predictions for the NASA Galileo and Ulysses RTG's during their mission lifetime of several years. Also, the Final Safety Analysis Report Addenda are being issued. Launch support interface activities with NASA's Jet Propulsion Laboratory and KSC are being increased to support launches of the Galileo and Ulysses spacecraft. The fabrication of the MITG ground demonstration unit is being completed, and testing is being started.

In FY 1987, the final technical report for the GPHS-RTG effort will be issued and post-launch data reduction and performance analyses of the flight generators will be accomplished. Also, all spare space hardware will be retrieved, protectively packaged, and stored. Analyses of all component life test data, including the mission flight units data, will be continued to update the mission prediction data requirements. Completion of the MITG development program is required to meet planned civilian and certain potential military missions. In particular, NASA plans to develop a new versatile spacecraft called the Mariner Mark II, which will be designed to accommodate such missions as the Comet Rendezvous Asteroid Flyby, the Saturn Orbiter/Titan Probe, and the Main Belt Asteroid Rendezvous. The MITG is an enabling technology for these missions, which are too far from the sun to use solar panels. The MITG development program through ground engineering test is planned to be completed in order to start the flight system program in FY 1988.

To meet space mission goals of greater power with lower weight, efforts are under way to improve thermoelectric materials for future missions through: (1) limited R&D on the electrical contacting of silicon germanium thermoelectric materials, (2) the independent evaluation of the thermoelectric materials properties, and (3) evaluation of degradation mechanisms and material interactions.

In the terrestrial RTG area, support is provided to the Special Applications element, particularly through the heat source design and fabrication facilities at the DOE laboratories. A range of RTG's have been used and are planned to be used in the military for special applications. It is expected that the 36 RTG's delivered since early 1977 will continue to be used for many years, but some replacements will be required because of age. The HPG Mod-3 RTG can continue to use the multihundred watt heat source fuel until the supply is exhausted, after which it can use the GPHS fuel technology that was developed for the NASA space missions. However, the new low-wattage RTG's that are expected as the future requirement will require a new heat source design to meet the objectives of RTG compactness and a very long lifetime in a severe operating environment.

Because of the importance of these military RTG's and delivery requirements, a major effort is planned to support their development and delivery. The Mound Plant will assume the responsibility to assemble and test these terrestrial RTG's as it has for the space RTG's. Thus, in FY 1987, Mound must begin the facility modifications for assembly and testing of the military HPG Mod-3 RTG planned for delivery in 1988. The Mound Plant, LANL, ORNL, and the Savannah River Plant will provide heat source manufacturing and design support to the military isotope power system design studies being conducted under the Special Applications element and the DIPS effort.

In order to meet the requirements of these compact, low-wattage RTG's, it is necessary to begin heat source design and the long-lead procurement and fabrication of heat source components in FY 1987. As the lead heat source laboratory and RTG assembly/testing organization, the Mound Plant will oversee the necessary hardware work while LANL carries out the safety testing required to support the Ground Safety Analysis Report and packaging requirements.

The flight-related reviews of the GPHS have shown a need to continue the efforts to improve the design margin for future space shuttle flights. The improvement program will involve LANL, the Applied Physics Laboratory, and other safety and design organizations, plus ORNL and Mound in a focused effort to further enhance the performance of the GPHS.

During the production campaign for the Galileo and Ulysses missions, several areas were identified in which production improvements could be made that would enhance the Department's production capabilities while reducing the number of rejections of heat source components and hence the unit costs. A key element of this is the heat source materials program at ORNL where improved processes and forming techniques promise improved yields at lower unit costs of: (1) the iridium alloy that is used to encapsulate the fuel pellets for military and civilian RTG's and DIPS and (2) the carbon sleeves that provide thermal insulation for the heat sources inside the RTG's and DIPS. During FY 1987, ORNL will demonstrate production improvements of the iridium and carbon components. Fabrication support to DIPS will be provided. ORNL will also provide the nondestructive examination technology to support upcoming flight systems, such as the MITG.

Under the RTG element, the Department's isotope power system nuclear facilities will be maintained. In addition to the Mound Plant and ORNL activities discussed in the previous paragraphs, the Savannah River Plant's Plutonium Fuel Form facility will be maintained in a production readiness status during FY 1987. Production maintenance activities will be performed, including tests of safety-related systems and the exercising of key process equipment on a monthly, weekly, and daily basis. Selective preventive maintenance will be conducted to prevent degradation of key process equipment and to ensure availability of critical spare/replacement parts, especially long-lead items necessary to permit ready start-up of the plutonium-238 fuel pellet production/encapsulation early in FY 1989. Technical support will also be provided for the coordination of fuel form production planning with other Government laboratories and systems contractors.

Because of the unique operating environments of RTG's, it is necessary that the reliability and quality of the product be assured. Therefore, independent reliability and quality assurance support to the terrestrial RTG effort and independent quality control for refurbishment and regassing of HPG Mod-3 RTG's will be provided. Also, operation analysis of facilities using plutonium-238 fuel will be conducted to fulfill safety requirements, including risk management review of assembly and testing operations.

Technical support to the isotope power system effort in the areas of independent analysis, component testing, conceptual design evaluations, and application studies for terrestrial and space isotope power systems will be continued. Isotope power system survivability studies will be supported, and system analyses in support of design work on a heat source design with improved margins will be carried out.

In keeping with the plans to pursue the technology development of advanced conversion materials, the improved thermoelectric materials effort will be continued. Optimum silicon germanium (SiGe) composition (SiGe ratio, alloy addition, and dopant level) and processing parameters for both negative and positive type SiGe thermoelectrics exhibiting a 25 percent improvement in performance over standard GPHS-RTG SiGe materials will be pursued.

Independent safety reviews of proposed low-wattage, terrestrial RTG designs will be conducted, and tests and evaluations to support safety reviews of these and other planned isotope power systems will be pursued. As part of the independent safety effort, fuel behavior experiments in several media environments will be conducted in support of safety analysis reports and independent risk assessments of military isotope power system designs. It is planned to update risk models using experience developed in the Galileo/Ulysses flight programs and to provide risk assessments of improved heat source designs for planned future missions, including independent thermal analysis for the terrestrial RTG designs. Also, an aerothermal analysis handbook will be prepared for use by isotope power system designers.

Aerothermal analyses will be conducted on proposed heat source designs to improve the margin of safety.

(Capital equipment):

In FY 1987, a variety of essential capital equipment is required to support the ongoing facility and engineering development activities. The Mound Plant plans to design a new small, low-wattage RTG glovebox line required to support the DOD RTG as part of the effort to modify the assembly and testing facilities to accommodate the smaller terrestrial RTG's. Equipment required to prepare the F-line system for assembly of the DOD HPG Mod-3 RTG planned for assembly and delivery in FY 1989 will be produced. Miscellaneous process and test equipment needed to maintain heat sources and RTG assembly and test facilities in a state-of-readiness for future civilian and military programs will be obtained, e.g., replacement fixtures, recorders, pumps, amplifiers, gauges, electrical measuring equipment, analyzers, heater elements, manipulators, circuit boards, accelerometers, strain gauges, etc., required to maintain system operating conditions.

Savannah River Plant will complete and check out a new Metallographic Facility required in support of plutonium-238 fuel form production/encapsulation activities scheduled to start in FY 1989. Miscellaneous items of capital equipment will be procured, such as cell windows, manipulators, and special tools required to support effective production maintenance and to ensure immediate plutonium-238 fuel form production startup in FY 1989. A high temperature vacuum furnace is to be procured to sustain iridium alloy production capability at ORNL. Fabrication and testing equipment will be purchased for the multicouple devices for the MITG program in FY 1987. Los Alamos will obtain special handling fixtures required to support the new low-power terrestrial RTG effort and test equipment for the safety improvement program.

Special Applications (Operating expenses):

In order to meet our obligation to deliver low-wattage RTG's for special terrestrial applications, the Department is continuing its efforts to develop and demonstrate the necessary technology. Missions that involve very long duration and unattended operations cannot be accomplished with conventional power supplies. During FY 1986, investigations are continuing into the thermoelectric module technology, and a primary candidate and alternate designs are undergoing environmental and performance tests. Modules of the selected thermoelectric technology are being assembled into multiple test fixtures, and a demonstration system for long-term performance testing is being assembled.

In FY 1987, the demonstration system will continue on long-term testing to verify performance predictions. Additional thermoelectric modules will be placed on test under predetermined conditions to support RTG performance predictions and reliability analyses. Also, the Department will continue its system studies and development of RTG design concepts to support projected terrestrial applications.

	FY 1986 Approp.	FY 1987 Request
Facilities		
Operating expenses	$124,173	$115,200
Capital equipment	4,503	2,800
Construction	3,560	3,800
Total	$132,236	$121,800

The availability of key test facilities is essential to meet the overall objectives of the Nuclear Energy Research and Development program. Facilities provide unique testing capabilities required for the development of safe, reliable, environmentally acceptable, and efficient nuclear power systems suitable for space, military, and civilian applications. Nuclear energy facilities conduct experiments for fusion technology; for cooperative technology programs with other countries; for developing nonnuclear energy resources, such as coal, solar, and geothermal; and for other private and Government organizations, such as the EPRI and the NRC programs.

In recent years, several facilities have been shut down, and steps have been taken to consolidate activities to reduce costs and to improve safeguards and security. At the Argonne National Laboratory (ANL) East site in Illinois, the Zero Power Reactors (facilities for reactor criticals) have been shut down, and the nuclear material has been transferred to the ANL-West site in Idaho. The Engineering Test Reactor, located at INEL, has been shut down, and the Thermal Hydraulic Out-of-Reactor facility at ORNL was shut down in FY 1985. Actions are proceeding in FY 1986 at the LANL to close out fuel examination hot cells and to consolidate requirements at other test sites. Several test facilities at the Energy Technology Engineering Center (ETEC) have been shut down or placed in standby, including the world's largest sodium pump test facilities. In FY 1985, proposals were solicited for a private sector funded cogeneration addition to ETEC. Plans call for this privately financed cogeneration addition to be leased to ETEC to sell electricity during steam generator testing. The sale of electricity will be used to offset costs of ETEC operations.

The Department maintains a continuous effort to improve the efficiency of its facilities so that the limited resources can be focused on priority national needs. As a result of these consolidations and cost reduction measures, the test facility efforts are presently focused at ETEC, ANL-West, and HEDL.

ETEC is the program's nonnuclear component testing center. Certain developmental hardware, software, and instrumentation can be tested in this nonnuclear environment with greater ease and flexibility than in a nuclear situation and at lower cost. During FY 1986, ETEC test operations include: key feature tests involving natural circulation and advanced shutdown heat removal systems for advanced plant concepts; start of performance testing of the helical coil steam generator model at limited power levels; and test activities that support efforts on plant design simplification that will provide major reductions in plant design, construction, and operating costs.

At ANL-West, the EBR-II, the Nation's only operating LMR powerplant, provides important information on the long-term reliability of LMR's. Despite the diversity and complexity of the experimental program, EBR-II operations have achieved an average plant capacity factor of 71 percent over the last 10 years providing reliable electric power to INEL. The EBR-II has unique testing capabilities, and tests being being conducted in FY 1986 include: the effects of running-beyond-cladding-breach; response of fuel to operational transients; and plant response to upset conditions. EBR-II also serves as an important test bed for innovative LMR design key features, such as flexible pipe joints, improved materials, and instrument and control system improvements. In FY 1986, full completion of the TREAT Upgrade project is being deferred to permit the conduct of defense program tests and a series of tests to substantiate the inherent safety characteristics of metal fuel for application in advanced reactors. The TREAT Upgrade project will be completed within existing appropriations consistent with the experimental program priorities. The Hot Fuel Examination Facility is an essential support facility for the EBR-II, TREAT, and the Fast Flux Test Facility (FFTF) at HEDL. The Zero Power Plutonium Reactor is the Nation's largest critical facility and is being utilized in a follow-on joint U.S./Japanese program to study the physics of heterogeneous cores.

The FFTF at HEDL is the most modern and powerful fuels and materials irradiation test reactor in the world. Since criticality in 1980, FFTF operations have achieved a world's record for LMR continuous operation at full power (101 days) and the burnup of fuel well beyond the goal burnup of 80,000 megawatt days per metric ton. During FY 1986, the following ongoing activities at FFTF are providing significant contributions to the development of nuclear technology important to the design of safe and reliable reactor systems: (1) demonstration of improved LMR inherent safety features provided by reactivity feedback effects; (2) demonstration of a longer life mixed oxide LMR fuel that will enable reductions in fuel fabrication, significant increases in reactor operating times, and a corresponding reduction in radiation exposure to personnel; and (3) testing of an advanced control concept that uses artificial intelligence for enhancing both the operations and maintenance functions of advanced reactors and has the potential for increasing operations/maintenance personnel productivity. In addition, the consolidation of plutonium handling activities to the 400 Area will be completed. Also, the Secure Automated Fabrication (SAF) line, which will produce fuel for the FFTF, is being completed in FY 1986. Presently, there are no commercial suppliers in the United States for mixed oxide fuel production. SAF line technology transfer to the private sector will be conducted to enable U.S. commercialization as market forces dictate.

The safeguards and program assurance efforts are integral to facility operations and include physical security systems and materials control and accountability at ANL and HEDL. This activity is essential to ensure an integrated safeguards system for Agency facilities within the nuclear energy sector that acquire, use, store, and dispose of special nuclear materials. Program assurance efforts include safety and quality assurance evaluations of nuclear energy facilities and programs.

In FY 1986, the primary emphasis of the facilities testing activity is being directed to support the civilian reactor development program. However, substantial support is also being provided to other programs, including space, defense, fusion, NRC, and others. The professional expertise and facility testing capabilities at the principal nuclear energy sites provide these programs with essential technical resources. Activities being performed for these other programs include: (1) irradiation of candidate materials in the FFTF for the United States and Japan's fusion programs; (2) irradiation of SP-100 reactor candidate fuels and materials in the EBR-II; (3) technical feasibility and proof-of-principal testing in the TREAT for a national defense effort; (4) performance testing of LWR pressure isolation valves in ETEC for NRC; and (5) design and trade-off studies by ETEC in support of space propulsion system development at the Lawrence Livermore National Laboratory. Facilities utilization by other programs is projected to markedly increase as a result of the technical capabilities of these facilities and the emerging requirements for nuclear powerplants in a wide range of power sizes to meet a broad spectrum of space, defense, and civilian requirements.

A cost-sharing approach for key facilities will be established that will more equitably distribute costs among users and provide an integrated DOE approach for optimum facility utilization. This cost-sharing approach will be implemented, to the degree practicable in FY 1987, with full implementation planned for FY 1988 and beyond. Proper allocation of facility costs to users, including private industry, foreign countries, NRC, DOD, and other DOE programs, will permit essential technology programs to be conducted at reduced programmatic funding levels.

In FY 1987, the facilities and testing activity will be directed to the changing civilian, military, and space nuclear power requirements. Civilian advanced converter concepts will require special tests for evaluation of fuels performance and reactor dynamics. Irradiation testing is assuming a more critical position in analysis of materials and fuel performance for military and space reactor applications. The efforts planned for FY 1987 in support of the civilian, space, and defense needs include reactor safety, fuel performance, and component testing for advanced reactor concepts, irradiation of candidate core materials for space reactor use, proof of principal and feasibility transient testing for an advanced defense system, irradiation of SP-100 fuel and cladding, cold checkout of the SAF line, run-beyond-cladding breach and operational transient testing under the joint U.S./Japan cooperative program, transient testing for the U.S./United Kingdom exchange agreement, irradiation of material specimens for the U.S. and Japan's fusion programs, and tests supporting reactor plant simplification and cost reduction features. Facilities support of international agreements, other DOE programs, and non-DOE programs will be on a cost-sharing basis.

(Capital equipment):

The requested funding will provide for the procurement of special test and hardware and equipment, such as thermocouples, pressure transducers, and other special hardware to conduct experiments at facilities.

(Construction):

The requested funding provides for completion of the ANL-West physical security upgrade project (85-N-602), for general plant projects at HEDL and ETEC, and for reactor modifications at ANL and HEDL that improve efficiency and reliability in the conduct of test programs. Additional information is provided in the attached construction project data sheets.

	FY 1986 Approp.	FY 1987 Request
Water Cooled Breeder		
Operating expenses........................	$ 18,955	$ 13,800
Total...................................	$ 18,955	$ 13,800

The Water Cooled Breeder FY 1987 funding level of $13,800,000 is a planned decrease of $5,155,000 from the FY 1986 appropriation.

The Water Cooled Breeder activity is developing a self-sustaining breeder nuclear reactor that is cooled and moderated with ordinary (light) water and fueled with uranium-233 and thorium. If proven, the concept would make thorium, which has plentiful reserves, available for industry use as a source of energy.

The principal objectives of this activity are to: prove that breeding can be achieved in a light water nuclear powerplant using a thorium/uranium-233 fuel system; confirm a practical way to use thorium, a plentiful source of fuel for which there has been no major energy-related use; show the feasibility of installing cores of the light water breeder type in pressurized water reactor plants using existing types of plant components and systems; and make the technology developed under the program available to the commercial industry.

A light water breeder core was installed in the Shippingport Atomic Power Station reactor in 1977. During the next 5 years, the light water breeder core accumulated nearly 29,000 effective full power hours while supplying electric power to the Duquesne Light Company distribution system. Throughout this period, the core performed successfully in both the sustained high power operation and periodic swing load operation.

In late 1982, the Shippingport reactor was shut down and under went end-of-life testing and defueling. The shipment of spent fuel to the Naval Reactors Expended Core Facility in Idaho was completed in late 1984. Core evaluation is underway at the Expended Core Facility to verify core performance, including breeding characteristics.

The Water Cooled Breeder activity will be completed in FY 1987, bringing to fruition over 20 years work in validating a major investment. Successful confirmation of breeding will provide the basic technology for potentially meeting this country's electric power requirements for hundreds of years.

The efforts to be conducted and funding levels within the Water Cooled Breeder activity in FY 1987 are: (1) Defueling activities ($3,600,000) and (2) Core evaluation ($10,200,000).

Defueling Activities (Operating expenses):

Defueling activities consist of preparation and shipment of fuel for long-term storage, cleaning up facilities, and technical documentation.

Defueling activities in FY 1987 will include: drying and sealing remaining spent fuel assemblies and individual fuel rods in storage containers; loading casks and shipping them to the Idaho Chemical Processing Plant for long-term storage; cleaning up light water breeder reactor manufacturing facilities; and publishing final reports on reactor operation, end-of-core-life test results, and defueling.

Core Evaluation (Operating expenses):

The core evaluation effort is essential to determining the success of the light water breeder reactor core. Detailed evaluation of spent fuel assemblies at the Expended Core Facility will verify core performance and breeding characteristics.

Core evaluation work in FY 1987 will include: completing nondestructive assay of about 500 fuel rods to confirm breeding; completing documentation of the technology for use by industry; and completing core and structural materials examinations to determine the performance of the light water breeder reactor. The examinations include measurements of fuel assembly bow, rod support grid wear and spring force, fuel rod spacing, clad corrosion, characterization of fission gas release from fuel, and fuel pellet condition. These examinations will help assess whether the thorium/uranium-233 fuel system is a practical energy source.

	FY 1986 Approp.	FY 1987 Request
Program Direction		
Operating expenses........................	$ 8,080	$ 9,550
Total......................................	$ 8,080	$ 9,550

The requested funding provides for 119 full-time employees (FTE's) in FY 1987. In FY 1985 and FY 1986, prior year carryover funds were available to supplement this account allowing for reduced congressional requests in those years. The FY 1987 funding increase is necessary to cover the total cost of this activity in the budget year.

The Federal personnel are required in order to perform a broad array of functions at Headquarters and in the field in the conduct of research and development activities involving other Federal agencies, the nuclear industrial and utility communities, and foreign governments. This line item does not include estimates for Federal personnel costs and positions for Water Cooled Breeder activities that are inseparable from those included in the Naval Reactors development program.

Some of the major activities associated with the management of the Nuclear Energy R&D program include the following:

- Performing long- and short-term program planning; establishing technical objectives, work scope, and resource levels; establishing procedures and publishing guidance; and integrating multiple field installations and contractor activities into a cohesive effort.
- Performing management functions, including assessing technical progress, interfacing work related work scope, resolving problems that prevent milestone achievement, ensuring safety, maintaining cost and schedule per established baselines, etc.
- Interacting with the nuclear industrial/utility community and with other Federal agencies, state, and local governments; and responding to numerous public and Congressional inquiries.
- Performing all administrative aspects, such as procurement, budgeting, preparing financial plans, participating in Congressional hearings, etc.

- Supporting international collaboration efforts at overseas and field locations.

Funding of $9,550,000 will be allocated as follows: $8,716,000 for personnel compensation and benefits, $500,000 for travel, and $334,000 for contractual services.

DEPARTMENT OF ENERGY
FY 1987 CONGRESSIONAL BUDGET REQUEST
CONSTRUCTION PROJECT DATA SHEETS
NUCLEAR ENERGY - PLANT AND CAPITAL EQUIPMENT
ENERGY SUPPLY RESEARCH AND DEVELOPMENT ACTIVITIES
NUCLEAR ENERGY RESEARCH AND DEVELOPMENT

(Tabular dollars in thousands. Narrative material in whole dollars.)

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1. Title and location of project: SP-100 Ground Engineering System (GES) Test Facility Modification
Bldg. 309, Hanford Engineering Dev. Lab.

2. Project No.: 86-N-105

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3. Date A-E work initiated: FY 1986

3a. Date physical construction starts: 3rd or 4th Qtr FY 1986

4. Date construction ends: 1st Qtr FY 1989

5. Previous cost estimate: $16,000
Date: January 1985

6. Current cost estimate*: $22,724
Less amount for PE&D: 0
Net cost estimate: $22,724
Date: December 1985

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7. Financial schedule*:

Fiscal Year	Authorization	Appropriations	Obligations	Costs
1986	$ 1,924	$ 1,924	$ 1,924	$ 1,924
1987	5,000	5,000	5,000	5,000
1988	14,800	14,800	14,800	14,800
1989	1,000	1,000	1,000	1,000
1990	0	0	0	0

*This cost estimate is preliminary and will be revised when the facility cost at the selected site is approved. In November 1985 the Hanford Engineering Development Laboratory was selected and work was started to define the conceptual design for the facility modifications. Approval of facility costs is expected by mid-FY 1986.

CONSTRUCTION PROJECT DATA SHEETS

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1. Title and location of project: SP-100 Ground Engineering System (GES) Test Facility Modification
Bldg. 309, Hanford Engineering Dev. Lab.

2. Project No.: 86-N-105

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8. Brief Physical Description of Project:

The project consists of modifying Bldg. 309 at the Hanford Engineering Development Laboratory beginning in FY 1986 and ending in FY 1989 in preparation for the SP-100 Ground Engineering System test scheduled to begin in FY 1990.

9. Purpose, Justification of Need for and Scope of Project:

In 1983, the Department of Energy (DOE), the National Aeronautics and Space Administration (NASA), and the Defense Advanced Research Projects Agency (DARPA) entered into an agreement to jointly develop and fund space nuclear reactor power system technology. Since that time the Strategic Defense Initiative Organization (SDIO) has replaced DARPA as the DOD participant. The goal of this triagency program is to develop safe, compact, light weight, durable (7 years at full power), high power multi-hundred kilowatt electric (approximately 20-1000 kWe) class space reactor power system technology to enable a broad class of emerging military and civil space missions in the early to mid-1990's and beyond. DOE has primary responsibility for developing and ground testing the nuclear subsystem.

The ground test phase is planned to continue until FY 1991 at a total cost of $450,600,000, of which DOE's share is approximately one-half. A $500,000,000 flight option is also identified and included as part of the SP-100 GES effort, as an option, but this option will only be exercised if and when a firm mission commitment to SP-100 technology is made and approval is obtained from the DOE Acquisition Executive. The objective of the SP-100 GES effort is to develop and demonstrate SP-100 technology flight readiness for dedicated use in the early to mid-1990's and beyond. In this regard, ground demonstration testing is required and will involve the development of a manufacturing base and component subsystem and system performance, safety, and engineering data sufficient to support a flight application program. Therefore, a dedicated facility will be required to support this effort.

CONSTRUCTION PROJECT DATA SHEETS

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1. Title and location of project:

SP-100 Ground Engineering
System (GES) Test Facility
Modification
Bldg. 309, Hanford
Engineering Dev. Lab.

2. Project No.: 86-N-105

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10. Details of Cost Estimate:

The selection of a preferred site was not made until early November 1985. Therefore, detailed cost estimates are not yet available and will be dependent upon the facility design to be utilized at the HEDL site.

11. Methods of Performance:

Modification to existing DOE facilities will begin with preliminary design of required modifications, to be followed by detailed design and actual accomplishment of the facility modifications.

12. Funding Schedule of Project Funding and Other Related Funding Requirements:

To be determined when the conceptual design for facility modification is agreed upon.

13. Narrative Explanation of Total Project Funding and Other Related Funding Requirements:

To be determined when the conceptual design for facility modifications is agreed upon and the system development contractor estimates are more firmly established.

DEPARTMENT OF ENERGY
FY 1987 CONGRESSIONAL BUDGET

CONSTRUCTION PROJECT DATA SHEETS
NUCLEAR ENERGY - PLANT AND CAPITAL EQUIPMENT
ENERGY SUPPLY RESEARCH AND DEVELOPMENT
NUCLEAR ENERGY RESEARCH AND DEVELOPMENT

(Tabular dollars in thousands. Narrative material in whole dollars.)

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1. Title and location of project: General plant projects
2. Project No.: 87-N-102

3. Date A-E work initiated: 1st Qtr. FY 1987
5. Previous cost estimate: None
Date:

3a. Date physical construction starts: 3rd Qtr. FY 1987
6. Current cost estimate: $ 2,200
Less amount for PE&D: 0
Net cost estimate: $ 2,200
Date: December 1985

4. Date construction ends: 4th Qtr. FY 1989

7. Financial schedule:

		Costs					
Fiscal Year	Obligations	FY 1983	FY 1984	FY 1985	FY 1986	FY 1987	After
1982	$ 7,468	$ 4,163	$ 1,387	$ 380	$ 246	$ -	$ -
1983	3,000	187	1,679	737	397	-	-
1984	4,000		486	1,787	1,335	392	-
1985	5,700			1,252	2,995	1,100	353
1986	1,732				360	670	702
1987	2,200					560	1,640

8. Brief physical description of project:

These small construction projects provide for the many alterations, additions, modifications, rehabilitations and replacements required annually at the Energy Technology Engineering Center (ETEC) and the Hanford Engineering Development Laboratory (HEDL) to maintain the facilities and sites in a condition suitable to support space, defense, and civilian nuclear power activities. In essence, projects will provide for efficiency of operations, improvement in test capabilities, and improvements in health, safety, and fire protection conditions. The request also includes the costs of installed capital equipment integral to the subproject.

CONSTRUCTION PROJECT DATA SHEETS

1. Title and location of project: General plant projects 2. Project No.: 87-N-102

9. Purpose, justification of need for, and scope of project:

Work under general plant projects (GPP) is essential to protect and upgrade the government's investment by preventing excessive deterioration and obsolescence. Support of this type is necessary to meet new and continuing needs of research and development programs, and to provide for a proper health and safety environment. The projects include modifications or improvements to existing buildings and facilities for continuing needs of research and development programs supporting space, defense and civilian nuclear power applications, and to provide for safe and economical operations. The projects include modifications or improvements to existing buildings and other facilities; building additions to house machinery, equipment and personnel; construction of small buildings; replacement or additions to roads and utility lines; and general area improvements. Two examples of the highest priority projects are identified below.

ETEC

Rehabilitation of Facilities and Access Areas. Some of the facilities, buildings, and related utility equipment has been in service for time periods exceeding the normal life of the item, resulting in high maintenance costs and reduced reliability. Access areas have been subject to heavy service and to erosion due to abnormal weather conditions. Activities will be performed site-wide to reduce the backlog of degraded conditions. Activities include safety and fire protection items such as replacement of PCB-filled electrical transformers, rehabilitation of building weatherproofing, facility improvements in support of space, defense, and civilian test program requirements, replacement of site and building utility components, and paving restoration and erosion control as part of the real property maintenance program.

HEDL

Real Property Maintenance. Sites and existing facilities must continue to be maintained and serviced regarding fire safety capability, utilities, supporting services, roads, real property maintenance, etc., and upgraded to meet new safety/safeguards standards, particularly to ensure facility safety and availability to the NE program and other programs who would use them. The backlog of required improvements for these sites continues to grow. Examples of priority improvements that need to be done are (1) priority capital work orders to ensure continued safe, secure, and efficient facility and site operations, (2) facility fire station, alarm, and detection system upgrades, and (3) facility maintenance shop addition to alleviate access problems.

CONSTRUCTION PROJECT DATA SHEETS

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1. Title and location of project: General plant projects 2. Project No.: 87-N-102

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10. Details of cost estimate:

Details of cost estimates for these projects are not available at this time. Detailed cost estimates for general plant projects are normally made in connection with the Request for Directive after the job has been scoped and preliminary engineering completed.

11. Method of performance:

Design will be by the operating contractor and negotiated architect-engineer contracts. To the extent feasible, construction and procurement will be by fixed-price contracts and subcontracts awarded on the basis of competitive bids.

12. Funding schedule of project funding and other related funding requirements:

No narrative required.

13. Narrative explanation of total project funding and other funding requirements:

No narrative required.

DEPARTMENT OF ENERGY
FY 1987 CONGRESSIONAL BUDGET

CONSTRUCTION PROJECT DATA SHEETS
NUCLEAR ENERGY - PLANT AND CAPITAL EQUIPMENT
ENERGY SUPPLY RESEARCH AND DEVELOPMENT
NUCLEAR ENERGY RESEARCH AND DEVELOPMENT

(Tabular dollars in thousands. Narrative material in whole dollars.)

1.	Title and location of project:	ANL-West physical security upgrades, Argonne National Laboratory, INEL, Idaho	2.	Project No.: 85-N-602	
3.	Date A-E work initiated:	2nd Qtr. FY 1985	5.	Previous cost estimate: Date: December 1985	$ 2,000
3a.	Date physical construction starts:	3rd Qtr. FY 1986	6.	Current cost estimate: Less amount for PE&D: Net cost estimate: Date: January 1986	$ 1,966 0 $ 1,966
4.	Date construction ends:	4th Qtr. FY 1987			

7. Financial schedule:

Fiscal Year	Authorization	Appropriation	Obligations	Costs
1985	$ 2,000	$ 500	$ 500	$ 200
1986	0	866	866	666
1987	0	600	600	1,100

8. Brief physical description of project:

Upgrade physical security systems as required in support of DOE-CH inspections and recommendations and the Sandia Laboratories "Safeguards Vulnerability Analysis Baseline," March 1983 study.

CONSTRUCTION PROJECT DATA SHEETS

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1. Title and location of project: ANL-West physical security upgrades, Argonne National Laboratory, INEL, Idaho

2. Project No.: 85-N-602

(a) Expand the General Site Security System Operational Capabilities

(1) Design and install dual computerized intrusion detection and assessment annunciation and control centers, both in hardened facilities, one acting as a totally redundant system to the other.

(2) Provide an addition of pan/tilt/zoom camera assessment capability to the perimeter.

(3) Provide an addition of a second perimeter intrusion detection system.

(4) Provide for small upgrades as a result of the perimeter vulnerability analysis.

(b) Provide Additional Structural Delay Feature at the Fuel Manufacturing Facility.

(c) Provide Sensing and Assessment Capabilities at the Radioactive Scrap and Waste Facility.

9. Purpose, justification of need for, and scope of project:

The proposed projects are part of an overall safeguards and security upgrading program at ANL-West. The projects proposed in this budget request provide incremental improvements that complement features that are either in place or are proposed to be added with prior year funding.

The proposed systems will provide: 1) sensing and assessment capabilities not available, 2) will provide time delays for unauthorized entry into areas where Special Nuclear Materials (SNM) is stored or is "in-process," 3) will permit automated assessment of activities from the Hardened Communication Center (HCC), and 4) will provide an interface at HCC in Building 701 for tie-in with the Idaho National Engineering Laboratory (INEL) Central Facilities Area (CFA) security center.

CONSTRUCTION PROJECT DATA SHEETS

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1. Title and location of project: ANL-West physical security upgrades, Argonne National Laboratory, INEL, Idaho

2. Project No.: 85-N-602

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10. Details of cost estimate: *

a. Engineering	$ 400
b. Construction	1,460
c. Contingency	106
Total	$ 1,966

*This estimate is based on completion of final design.

11. Method of performance:

Design will be accomplished by the operating contractor and by an Architect/Engineer. Procurement will be by fixed-price contracts awarded on the basis of competitive bids where feasible and installation will be accomplished by a construction contractor and operating contractor forces.

12. Funding schedule of project funding and other related funding requirements:

Not required.

13. Narrative explanation of total project funding and other funding requirements:

Not required.

DEPARTMENT OF ENERGY
FY 1987 CONGRESSIONAL BUDGET
CONSTRUCTION PROJECT DATA SHEETS
NUCLEAR ENERGY - PLANT AND CAPITAL EQUIPMENT
ENERGY SUPPLY RESEARCH AND DEVELOPMENT
(Tabular dollars in thousands. Narrative material in whole dollars.)

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1. Title and location of project: Modification to reactors, various locations

2. Project No.: 87-N-101

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3. Date A-E work initiated: 1st Qtr. FY 1987

3a. Date physical construction starts: 3rd Qtr. FY 1987

4. Date construction ends: 4th Qtr. FY 1988

5. Previous cost estimate: None
Date:

6. Current cost estimate: $ 1,000
Less amount for PE&D: 0
Net cost estimate: $ 1,000
Date: December 1985

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7. Financial schedule:

Fiscal Year	Authorization	Appropriation	Obligations	Costs
1987	$ 1,000	$ 1,000	$ 1,000	$ 400
1988	0	0	0	600

8. Brief physical description of project:

This project will consist of modifications to the Experimental Breeder Reactor II (EBR-II) at the Argonne National Laboratory (ANL) site in Idaho, and the Fast Flux Test Facility (FFTF) complex at the Hanford Engineering Development Laboratory (HEDL) in the state of Washington. The improvements are based on operating experience and will help maintain the operating efficiency, capability, and reliability of operating these major reactor and support facilities.

9. Purpose, justification of need for, and scope of project:

Previous reactor operating experience and data acquisition have produced information relevant to improved reactor and support facility operations and improvements to maintain a high level of safety. The purpose of this project is to maintain the safety, efficiency, and reliability of major facility operations in support of space, defense, and civilian reactor applications. The following are highest priority subprojects currently identified.

1. Title and location of project: Modification to reactors, various locations 2. Project No.: 87-N-101

ANL-West

Experimental Breeder Reactor II (EBR-II) Critical Systems Mockup. This subproject will provide for the fabrication and assembly of a mockup of the EBR-II reactor and fuel handling system and will be located in the Instrument Test Facility (ITF)/Building, No. 772 at ANL-West. The mockup will include sections or portions of the reactor (1) vessel, (2) grid plate, (3) cover, (4) primary tank cover, (5) primary tank wall, (6) rotating plugs, (7) storage basket, (8) transfer arm, (9) catch basin, (10) core gripper, (11) core gripper holddown, (12) fuel transfer port, (13) outlet coolant piping, and (14) rotating plugs fusible seals. It will include elevated platforms for working areas and to simulate the reactor building operating floor levels, improved lighting for the mockup area, and data instrumentation equipment.

This modification will provide improved capability to handle, retrieve, or remove subassemblies in a timely manner from the reactor for some offnormal conditions. Avoidance of extended EBR-II outages will assure availability to produce electricity for the Idaho National Engineering Laboratory while providing fuels and materials irradiations in support of civilian, space and defense energy programs.

HEDL

Test Fuel Fabrication and Characterization. The purpose of this subproject is to provide the capability to fabricate pellets from various fuel blends and establish the pre-production parameters for the Secure Automated Fabrication line. This project is essential to the consolidation of plutonium operations in the HEDL 400 Area. The subproject scope will include facility modifications, utility tie-ins, and equipment design, fabrication and installation. Services to be provided include electrical, tie-in to the ventilation systems, various process gases and process cooling water.

10. Details of cost estimate:

Details of cost estimate for these efforts are not available at this time. Detailed cost estimate for modifications to reactors are normally made after the job has been scoped, and preliminary engineering completed.

CONSTRUCTION PROJECT DATA SHEETS

1. Title and location of project: Modification to reactors, various locations
2. Project No.: 87-N-101

11. Method of performance:

Design will be on the basis of negotiated architect-engineer contracts. To the extent feasible, construction and procurement will be accomplished by fixed-price contracts awarded on the basis of competitive bidding.

12. Funding schedule of project funding and other related funding requirements:

No narrative required.

13. Narrative explanation of total project funding and other funding requirements:

No narrative required.

DEPARTMENT OF ENERGY
FY 1987 CONGRESSIONAL BUDGET REQUEST
LEAD TABLE
NUCLEAR
ENERGY SUPPLY RESEARCH AND DEVELOPMENT

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1985 Approp.	FY 1986 Approp.	FY 1987 Base	FY 1987 Request	Request vs Base
Remedial Action and Waste Technology (NE)					
Formerly Utilized Sites Remedial Action Project					
Operating expenses.....	$ 17,600	$ 18,763	$ 18,763	$ 25,400	$+6,637
Capital equipment	200	192	192	200	+8
Subtotal...........	17,800	18,955	18,955	25,600	+6,645
Grand Junction Remedial Action Project					
Operating expenses	1,500	866	866	800	-66
Subtotal	1,500	866	866	800	-66
Uranium Mill Tailings Remedial Action Project					
Operating expenses	59,960	90,397	90,397	123,700	+33,303
Capital equipment	750	962	962	2,300	+1,338
Subtotal	60,710	91,359	91,359	126,000	+34,641
Surplus Facilities Program					
Operating expenses	29,130	39,787	39,787	56,000	+16,213
Capital equipment	120	144	144	400	+256
Subtotal	29,250	39,931	39,931	56,400	+16,469
West Valley Demonstration Project					
Operating expenses	47,150	61,581	61,581	79,000	+17,419
Subtotal	47,150	61,581	61,581	79,000	+17,419
Low-Level Waste					
Operating expenses	5,950	4,474	4,474	4,000	-474
Capital Equipment	150	96	96	0	-96
Subtotal	6,100	4,570	4,570	4,000	-570
Waste Treatment					
Operating Expenses	5,965	5,773	5,773	0	-5,773
Capital Equipment	300	433	433	0	-433
Subtotal	6,265	6,206	6,206	0	-6,206
Byproducts Utilization					
Operating Expenses	0	4,811	4,811	0	-4,811
Subtotal	0	4,811	4,811	0	-4,811

	FY 1985 Approp.	FY 1986 Approp.	FY 1987 Base	FY 1987 Request	Request vs Base
Remedial Action and Waste Technology (cont'd)					
Program Direction					
Operating expenses	1,590	1,768	1,768	2,300	+532
Subtotal	1,590	1,768	1,768	2,300	+532
Total					
Operating expenses	168,845	228,220	228,220	291,200	+62,980
Capital equipment	1,520	1,827	1,827	2,900	+1,073
Remedial Action and Waste Tech.	$170,365a/	$230,047b/	$230,047	$294,100c/	$+64,053
Staffing Total FTE	26	30	30	32	+2

Authorization: Sec. 31, P.L. 83-703
P.L. 95-604 (Uranium Mill Tailings)
P.L. 92-314, P.L. 95-236 (Grand Junction)
P.L. 96-368 (West Valley)
P.L. 96-573 (Low-Level Waste)

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a/ The FY 1985 amount reflects a reduction of $2,600,000 for IG Audits/prior year deobligation Management Initiative Savings; $5,300,000 for the General Reduction; and $50,000 provided for Small Business Innovative Research in accordance with P.L. 97-219.

b/ Adjustments to the FY 1986 appropriation are described in the table following the Nuclear tab in this volume.

c/ The FY 1987 amount reflects a reduction of $1,722,000 for Management Initiative Savings.

DEPARTMENT OF ENERGY
FY 1987 CONGRESSIONAL BUDGET REQUEST
SUMMARY OF CHANGES
ENERGY SUPPLY RESEARCH AND DEVELOPMENT
Remedial Action and Waste Technology
(In thousands of dollars)

FY 1986 Appropriation enacted	$230,047
Built in increases and decreases	0
FY 1987 base	230,047

Program increases and decreases:

Formerly Utilized Sites Remedial Action Project	+6,645

- o Continue remedial action and engineering activities at the highest priority sites. Initiate remedial action at Albany, Oregon; accelerate work at the St. Louis Airport Disposal Site consistent with project plan for disposal of Latty Avenue site waste; and proceed with surveys for selection of disposal sites in New Jersey and New York.

Grand Junction Remedial Action Project	-66

- o Complete all remedial action under this project, consistent with State of Colorado cost-sharing plans.

Uranium Mill Tailings Remedial Action Project	+34,641

- o Continue previously initiated processing site and vicinity property remedial action with completion at Salt Lake City and Shiprock; continue remedial action at 2 sites (Lakeview and Tuba City) and initiate remedial action at 6 additional processing sites (Ambrosia Lake, Durango, Grand Junction, Gunnison, Mexican Hat, and Riverton) and associated vicinity properties; complete surveys of 3,450 vicinity properties; and continue engineerng and NEPA efforts for other sites. Propose legislation to extend project through FY 1993.

Surplus Facilities Management Program	+16,469

- o Initiate conceptual design and remedial action for the Weldon Spring Site. Begin remedial action at the Monticello mill site, preliminary stablization at the contaminated Power Burst Facility in Idaho, and continue cleanup of contaminated facilities at various DOE sites.

Summary of Changes (cont'd)

West Valley Demonstration Project .... +17,419

- o Complete procurement of major systems and equipment for vitrification of high-level radioactive waste, scheduled to begin in early FY 1989.

Low-Level Waste .... -570

- o Provide technical assistance to States and regions for development of new low-level waste (LLW) disposal facilities.

Waste Treatment .... -6,206

- o Eliminate a program of research and development of a first generation high-level waste form; development of a second generation high-level waste form; and methods for treatment of civilian transuranic waste.

Byproducts Utilization .... -4,811

- o Phase out support of a civilian byproducts utilization program with primary emphasis on food irradiation applications.

Program Direction .... +532

- o Provides for 32 FTE's, an increase of 2 FTE's above the FY 1986 level, to manage remedial action and waste technology activities and increased funding to support overall program direction expenses.

FY 1987 budget request.. $294,100

	FY 1986 Appropriation	FY 1987 Request
Remedial Action and Waste Technology	$230,047	$294,100

The objectives of the Remedial Action and Waste Technology Program are to treat or stabilize radioactive wastes and perform decontamination and decommissioning at contaminated DOE and legislatively directed non-government facilities and sites; and facilitate development of a reliable national system for managing low-level radioactive wastes. The general approach applied to fulfilling the Remedial Action portion of this program is: (a) to verify the need for remedial action by conducting radiological surveys of suspected contaminated properties; (b) to define the method of accomplishing required remedial action, based on existing radiological criteria, by developing engineering options and conducting appropriate NEPA reviews; (c) to carry out the selected remedial action; and, (d) to certify completion of the remedial action consistent with existing radiological criteria.

The major activities under the Remedial Action and Waste Technology Program are: (1) formerly utilized sites remedial action project (FUSRAP); (2) remedial action at Grand Junction, Colorado (P.L. 92-314, as amended); (3) uranium mill tailings remedial action project (UMTRAP) for inactive uranium mill tailings sites (P.L. 95-604); (4) management of certain radioactively contaminated Department facilities declared surplus and resulting principally from civilian nuclear energy programs; (5) demonstration of the solidification of high-level radioactive wastes at West Valley for final disposal (P.L. 96-368); and (6) technical assistance to States and regions to assist them in developing new capacities for the disposal of low-level radioactive waste. International cooperative efforts, nuclear waste management training programs, and nuclear fuel cycle studies are also conducted under this program.

The major changes in the FY 1987 budget request include the following: initiate remedial action at the Albany, Oregon, FUSRAP site, begin the assessment process for selection of disposal sites in New Jersey and New York, and continue remedial actions and engineering for the highest priority FUSRAP sites; complete remedial action on all remaining properties under the Grand Junction Remedial Action Project and close out this program in FY 1988; complete remedial actions at the Salt Lake City, Utah, and Shiprock, New Mexico, UMTRAP sites, continue remedial action at the Tuba City, Arizona, and Lakeview, Oregon, sites and initiate remedial action at six additional processing sites, propose legislation to extend the UMTRA Project authorization through FY 1993; initiate remedial action at the Weldon Spring, Missouri, site, the Monticello, Utah, mill site, and the surplus contaminated Power Burst Facility at Idaho; continue procurement of major systems and equipment for solidification of high-level radioactive waste at West Valley, New York, now scheduled to begin in early FY 1989; eliminate a program of research and development of technologies for the treatment and immobilization of nuclear wastes in forms acceptable for transportation, storage, and disposal; and phase out support of a civilian byproducts utilization program which focused on food irradiation applications for food and other agricultural commodities.

	FY 1986 Appropriation	FY 1987 Request
A. Formerly Utilized Sites Remedial Action Project..........................	$18,955	$25,600
Operating Expenses	$18,763	$25,400

The Formerly Utilized Sites Remedial Action Project (FUSRAP) provides for remedial actions at former nuclear processing facilities, most privately owned, which became radioactively contaminated from Manhattan Engineer District or Atomic Energy Commission activities and which have not been decontaminated sufficiently to meet current health effects guidelines for unrestricted use. Because of the potential health risks, site utilization is limited and property values are in some cases greatly reduced. To remedy the situation the contamination will be either stabilized in-place, with restrictions placed on site use, or the contamination will be removed and disposed of at another location. Remedial action can only be undertaken at those sites for which legislative authority exists for DOE action. In FY 1983, authority existed for work on 15 such sites. Congress added four new sites and $5,000,000 in the FY 1984 Energy and Water Development Appropriations Act with direction to initiate, as a priority action, a decontamination and decommissioning project at these sites. In 1984 DOE added five more sites to the program based on a review of authority and the need for remedial action. In the FY 1985 Energy and Water Development Appropriations Act Committee reports, Congress directed DOE to acquire the former St. Louis Airport Storage Site for disposal of wastes from the nearby Latty Avenue site. In 1985 DOE added four more sites to the program based on a review of authority and the need for remedial action. These additions bring the total number of sites under this program to 29. Remedial action has been completed on six of these sites. Continuing reviews are underway to screen approximately 140 locations where contamination may be present and DOE remedial action could be needed. Disposal sites for removed materials, if required, will be arranged with Federal, State, and local authorities. Federally owned sites will be used for temporary storage. The Oak Ridge Operations Office is the lead field office in implementing this program.

Specific FY 1985 activities included:

- Niagara Falls Storage Site (NFSS), NY: Completed design engineering for all NFSS vicinity properties and completed remedial action for all but four vicinity properties.
- Middlesex Landfill, NJ: Continued remedial action; completed excavation of 15,000 cubic yards of contaminated soil and closed the site temporarily.
- Maywood, NJ: Completed cleanup of all designated vicinity properties at Maywood; began cleanup of the Ballod property; began expansion of the temporary storage area; installed monitoring wells.
- Wayne, NJ: Completed cleanup of the bus yard and the ballfield at Wayne; began stabilization of the onsite buried waste; installed monitoring wells.

- Colonie, NY: Completed cleanup of 24 vicinity properties at Colonie; began work for disposal of hazardous chemicals.

- Hazelwood, MO: Completed cleanup of the Latty Avenue ditches at Hazelwood; erected fencing around the storage site; covered the stored waste.

- St. Louis Airport Disposal Site (SLAPDS), MO: Completed stabilization of an eroding bank on Coldwater Creek; continued monitoring of the site.

- Middlesex Sampling Plant, NJ: Provided surveillance and maintenance.

- Palos Park, IL: Provided radiological surveillance.

- Continued National Environmental Policy Act (NEPA) documentation for other sites.

- Completed records search for approximately 100 sites; 140 sites remain to be completed by end of FY 1987.

- Completed radiological surveys for approximately 88 vicinity properties of which 25 were designated for remedial action.

In FY 1986 the following will be accomplished:

- Middlesex Landfill, NJ: Complete all remedial action.

- Maywood, NJ: Complete cleanup of the Ballod property south of the railroad spur. Complete characterization of the DOE Storage Site, Lodi commercial properties, and the Scanel properties. Complete design engineering for the north Ballod and railroad spur, the Scanel and the Lodi commercial properties. Complete expansion of the temporary storage area; provide surveillance and maintenance. Complete the preliminary engineering evaluation of stabilization and disposal options.

- Wayne, NJ: Complete cleanup of the residential vicinity properties and 35 percent of Sheffield Brook at Wayne; complete interim stabilization of the onsite buried waste; provide surveillance and maintenance.

- Colonie, NY: Complete cleanup of an additional 10 vicinity properties at Colonie; complete removal and disposal of the hazardous chemicals; provide surveillance and maintenance. Complete the preliminary engineering evaluation of stabilization and disposal options.

- Hazelwood, MO: Start onsite characterization of the Latty Avenue site; provide surveillance and maintenance.

- NFSS, NY: Complete remedial action on the remaining four vicinity properties; complete installation of the cap on the interim storage area.

- SLAPDS, MO: Acquire the site; begin site characterization and continue conceptual design; begin NEPA document preparation.

- Middlesex Sampling Plant, NJ: Provide surveillance and maintenance.

- Palos Park, IL: Provide radiological surveillance.
- Continue site designation record and authority reviews.
- Continue radiological surveys for site designations.

The FY 1987 budget request of $25,400,000 represents an increase of $6,637,000 above the FY 1986 operating expenses appropriation. Efforts will continue for the 29 currently authorized sites with increased funding for remedial action at the priority sites, as directed by Congress, and remedial action will be initiated at one additional site. The assessment process for selection of disposal sites in New Jersey and New York will be initiated.

Specific accomplishments planned for FY 1987 include:

- Maywood, NJ: Complete characterization of the Sears and Route 17 properties; complete design engineering for the Sears properties and residential properties in Lodi. Complete remedial action on the Scanel, the north Ballod, and the railroad spur properties; begin remedial action on the Sears property. Continue surveillance and maintenance.
- Wayne, NJ: Complete cleanup at Sheffield Brook down to the Pompton River; complete characterization in the Pompton River area. Continue surveillance and maintenance.
- Colonie, NY: Complete design engineering and remedial action for the remaining vicinity properties, 10 now designated and additions. Continue surveillance and maintenance.
- Hazelwood, MO: Continue site surveillance and maintenance. Complete site characterization.
- SLAPDS, MO: Complete site characterization, preliminary engineering and some design engineering.
- Albany, OR: Complete design engineering, begin and complete 40 percent of the remedial action at the Bureau of Mines Albany Metallurgical Center.
- NFSS, NY: Complete final report of remedial action.
- Middlesex Landfill, NJ: Complete final report of remedial action.
- Middlesex Sampling Plant, NJ: Continue surveillance and maintenance.
- Palos Park, IL: Continue radiological surveillance.
- NJ Disposal Site: Complete large area survey for geology and hydrology; complete small area survey; select three potential sites and start field work (drilling).
- NY Disposal Site: Start and complete large area survey; begin small area survey.
- Complete site designation record search and authority reviews.

- Continue site designation surveys and verification surveys.

	FY 1986 Appropriation	FY 1987 Request
Capital Equipment	$ 192	$ 200

Capital equipment funding is required in FY 1987 for replacement of obsolete instruments and other diagnostic equipment used in the field at remedial action sites and for the acquisition of various measurement instruments and equipment needed to obtain baseline information at the contaminated sites. These instruments include mobile field radiological testing apparatus, radiometric and radon monitors, and digital data collection systems.

B. Grand Junction Remedial Action Project.........................	$ 866	$ 800

Under Title II of Public Law 92-314, Congress authorized financial assistance to the State of Colorado, to limit radiation exposure resulting from the use of uranium mill tailings for construction purposes in Grand Junction, Colorado. This cooperative effort with the State of Colorado is administered by the Colorado Department of Health through the Grand Junction Project Office. The remedial action provides for removal of uranium mill tailings from the premises of an estimated 600 structures where radon daughter exposures exceed the Surgeon General's guidelines. Public Law 95-236 extended the time for property owners to apply for inclusion in the program through June 1980, and increased the authorized program funding. Federal funds cover 75 percent of the program costs with the State providing the balance. Contingent upon the availability of State funding, remedial action is expected to be complete in FY 1987 with final radiological surveys of completed properties being conducted in FY 1988. Remedial action on four high cost commercial structures has been postponed until near the end of the program in order to give higher priority to residential structures.

In FY 1985 the following was accomplished:

- Completed remedial action on 20 structures and initiated and completed remedial action on 13 additional structures, including 2 schools.
- Completed 54 effectiveness surveys of structures remedied in FY 1983 and FY 1984 to demonstrate compliance with the Surgeon General's guidelines.

In FY 1986 the following will be accomplished:

- Complete radiological assessments at all remaining properties.
- Complete remedial action on an estimated 40 properties, including 4 commercial structures.
- Complete 60 effectiveness surveys to demonstrate compliance with the Surgeon General's guidelines.

The FY 1987 budget request of $800,000 represents the required funding to complete the program. At this level of funding the Grand Junction Remedial

Action Project will complete remedial action on all remaining properties, currently estimated at 8 new properties and 8 reassignment locations.

	FY 1986 Appropriation	FY 1987 Request
C. Uranium Mill Tailings Remedial Action Project........................	$91,359	$126,000
Operating Expenses	$90,397	$123,700

The Uranium Mill Tailings Remedial Action Project is responsible for conducting remedial action at 24 sites and several thousand associated vicinity properties, as mandated by Public Law 95-604, "The Uranium Mill Tailings Radiation Control Act of 1978." Nine of the sites are designated as high priority, six as medium priority, and nine as low priority. The Act requires completion of the program within the seven years following the promulgation of final standards by the Environmental Protection Agency (EPA), which occurred in March 1983. The Department is proposing to extend the period of authorization until the end of FY 1993. This proposed action will be discussed in more detail later in this narrative. Remedial action will be conducted in accordance with cooperative agreements negotiated with the affected States and Indian tribes. Federal funds are to cover 90 percent of the remedial action costs (100 percent for those sites on Indian lands). The type of remedial action for the processing sites will be either to stabilize the mill tailings in-place, where feasible, or to remove the tailings to a new disposal site. In either case, the final disposal site will be Federally-owned and maintained under a license issued by the Nuclear Regulatory Commission (NRC). The program also includes the cleanup of an estimated 4,500 properties in the vicinity of the processing sites which have become contaminated with radioactive material derived from the sites. Engineering plans and environmental documents will be prepared for the cleanup and disposal operations at each site. The concurrences of the NRC and the affected State (or Tribe) are required for each site Remedial Action Plan. Day-to-day project management is provided by the Uranium Mill Tailings Remedial Action Project (UMTRAP) Office at Albuquerque, New Mexico.

In general, the project approach for each processing site includes: (1) development of a Remedial Action Plan; (2) National Environmental Policy Act (NEPA) review and required State/Tribe and NRC concurrence on the proposed remedial action; (3) detailed engineering; (4) remedial action; (5) certification of the completed remedial action; and (6) NRC licensing of the final disposal sites.

For additional details on schedules and activities for each of the processing sites and associated vicinity properties, please refer to the 22 UMTRAP Operating Expense Funded Data Sheets which are included with this submission.

The FY 1987 submission identifies the resource requirements required to meet an extended schedule beyond that established in Public Law 95-604. The project extension and current cost estimate take into consideration the complexity and experience gained in performing remedial action activities at processing sites and vicinity properties. The revised project plan is based on the following key assumptions: (1) 4,535 of the 8,156 designated vicinity properties will actually require cleanup in accordance with EPA standards, and

(2) seven of the tailings piles (i.e., Bowman, ND; Durango, CO; Grand Junction, CO; Lakeview, OR; Rifle, CO; Gunnison, CO; and Salt Lake City, UT) will be relocated.

Funding at the requested level for FY 1987 would require appropriations approaching $250,000,000 for FY 1988 and $200,000,000 for FY 1989 in order to complete the project within the currently authorized period of 7 years. The high peak in projected funding requirements results from the combined effects of a major increase in the total estimated cost (TEC) for the project and from delays encountered in reaching agreement among the many parties involved in remedial action plans. The increase in the TEC is based on actual project experience with both processing sites and vicinity properties and reflects higher than anticipated costs in meeting the requirements of the EPA standards, particularly in satisfying ground-water requirements and stabilizing tailings located in the floodplains, or, alternatively, relocating the tailings to new disposal sites.

In consideration of the effect these factors have on annual funding requirements and the large number of sites and vicinity properties which would have to be under construction simultaneously during the peak years, the Department is proposing legislation to extend the period of authorization until the end of FY 1993. This extension is consistent with the recommendation to extend the duration of the project made by the House Appropriations Committee in Report 99-195 accompanying the FY 1986 Energy and Water Development Bill.

During FY 1985 remedial action was underway on three processing sites and at more than 300 vicinity properties, and engineering design was in progress for additional sites on which construction will begin in FY 1986. Also, radiological surveys of vicinity properties were accelerated in order to determine how many of the approximately 8,000 possibly contaminated properties which have been identified, will actually require cleanup under the program.

Specific accomplishments for FY 1985 included:

- Canonsburg, PA: Completed 90 percent of the remedial action at the processing site and approximately 85 vicinity properties.
- Salt Lake City, UT: Completed engineering design and initiated and completed 12 percent of the remedial action at the processing site under the relocation to Clive, Utah, option. Completed remedial action at approximately 20 vicinity properties.
- Shiprock, NM: Completed 20 percent of the processing site remedial action and 12 vicinity properties.
- Durango, CO: Completed remedial action at 1 vicinity property. Continued work on the Remedial Action Plan, conceptual design, development of environmental documentation, and initiated design engineering.
- Grand Junction, CO: Initiated work on the Remedial Action Plan and conceptual design, and continued work on development of the environmental documentation. Completed cleanup of 15 vicinity properties and started work on an additional 121 properties.

- Riverton, WY: Continued development of the Remedial Action Plan, conceptual design, and environmental documentation. Started design engineering work. Completed remedial action on 11 vicinity properties.
- Gunnison, CO; Tuba City, AZ; Mexican Hat, UT: Continued work on the Remedial Action Plan, conceptual design, and development of environmental documentation.
- Rifle, CO; Monument Valley, AZ; Ambrosia Lake, NM; Naturita, CO: Initiated work on the Remedial Action Plan, conceptual design, and continued development of environmental documentation.
- Lakeview, OR: Completed environmental documentation. Initiated work on the design engineering.
- Edgemont, SD: Completed remedial action at 35 vicinity properties.
- Completed the survey and inclusion of approximately 1,600 vicinity properties.

Specific accomplishments and activities planned for FY 1986 are as follows:

- Canonsburg, PA: Complete remedial action at processing site and vicinity properties. Initiate surveillance and maintenance of the site.
- Salt Lake City, UT: Complete 70 percent of the remedial action at the processing site and approximately 60 percent of the vicinity property remedial action.
- Shiprock, NM: Complete 90 percent of the remedial action at the processing site and 100 percent of vicinity properties.
- Durango, CO: Complete approximately 25 percent of vicinity property remedial action. Complete environmental documentation, the Remedial Action Plan, conceptual design, and 60 percent of the design engineering.
- Gunnison, CO: Continue preparation of environmental documentation, the Remedial Action Plan, and conceptual design.
- Grand Junction, CO: Complete environmental documentation, the Remedial Action Plan, and conceptual design. Initiate design engineering. Initiate remedial action on approximately 160 vicinity properties.
- Rifle, CO: Continue work on the Remedial Action Plan, conceptual design, and environmental documentation.
- Riverton, WY: Complete the Remedial Action Plan, conceptual design and environmental documentation. Continue design engineering for the processing site.
- Tuba City, AZ; Mexican Hat, UT; Ambrosia Lake, NM: Complete environmental documentation, the Remedial Action Plan, conceptual design, and design engineering. Initiate remedial action at the Tuba City processing site.

- Monument Valley, AZ: Complete environmental documentation, the Remedial Action Plan, and conceptual design. Initiate design engineering.
- Lakeview, OR: Complete the Remedial Action Plan, conceptual design and design engineering. Initiate remedial action at the Lakeview processing site.
- Naturita, CO; Falls City, TX; Green River, UT; Slick Rock, CO: Continue work on the Remedial Action Plan, conceptual design, and environmental documentation.
- Maybell, CO; Belfield/Bowman, ND; Lowman, ID; Spook, WY: Initiate work on the Remedial Action Plan and conceptual design.
- Edgemont, SD: Complete remedial action on all vicinity properties.
- Complete the radiological survey of 2,950 vicinity properties.

The FY 1987 budget request of $123,700,000 represents an increase of $33,303,000 above the FY 1986 operating expenses appropriation.

Specific accomplishments planned for FY 1987 include:

- Canonsburg, PA: Continue site surveillance and maintenance.
- Shiprock, NM: Complete remedial action. Initiate surveillance and maintenance.
- Salt Lake City, UT: Complete processing site remedial action and vicinity property remedial action. Initiate surveillance and maintenance.
- Durango, CO: Complete 25 percent of processing site remedial action and 70 percent of vicinity property remedial action.
- Gunnison, CO: Complete design engineering and initiate processing site remedial action.
- Grand Junction, CO: Initiate and complete 5 percent of processing site remedial action. Initiate remedial action at approximately 800 vicinity properties.
- Rifle, CO: Complete the Remedial Action Plan, conceptual design, environmental documentation, and design engineering. Initiate vicinity properties engineering.
- Riverton, WY: Complete design engineering and initiate processing site remedial action.
- Tuba City, AZ: Complete vicinity property remedial action and 20 percent of processing site remedial action.
- Ambrosia Lake, NM; Mexican Hat, UT: Initiate processing site remedial action.

- Lakeview, OR: Complete 85 percent of processing site remedial action and complete work on 6 vicinity properties.
- Naturita, CO; Falls City, TX; Green River, UT; Slick Rock, CO; Belfield/Bowman, ND; Maybell, CO: Complete the Remedial Action Plan, conceptual design, and environmental documentation. Initiate design engineering.
- Lowman, ID; Spook, WY: Continue work on environmental documentation and initiate design engineering.
- Complete the survey of 3,450 vicinity properties, thus completing this work at all sites except Grand Junction, CO.

	FY 1986 Appropriation	FY 1987 Request
Capital equipment........................	$ 962	$ 2,300

The increase in capital equipment requirements for FY 1987 is primarily due to the higher operating level and a schedule which has several sites under construction concurrently. This schedule requires radon gas counting systems to be maintained at each site, whereas the original intent was to transfer equipment from site to site. The schedule also requires a large number of field measurements to be made and the inventory of maintenance/backup equipment and parts must be adequate to ensure that equipment-related personnel downtime is minimized. The types of equipment required include: health physics equipment, working level monitors, radon gas monitors, meteorological stations, counting chambers, radon daughter monitors and readout units, delta-gamma instruments, microcomputer systems, gamma-ray scintillometers, coring and augering equipment, and geochemistry laboratory equipment.

D. Surplus Facilities Program..............	$39,931	$56,400
Operating expenses	$39,787	$56,000

This program provides for the safe management and disposition of an inventory of surplus radioactively contaminated Department-owned facilities from the civilian nuclear energy development programs. After the facilities are decontaminated they are returned to other productive use as appropriate. All defense-related facilities are included in the Defense Nuclear Waste Management Budget. Currently 35 projects (including ore handling and processing, reactor, laboratory, and fuel fabrication facilities) are identified under this civilian activity. In addition, surveillance and maintenance of surplus facilities is provided to assure they remain environmentally safe until cleanup can be accomplished and improved methods for decontamination and decommissioning are developed which can be transferred to industry. A long range plan was completed in 1985 to establish the overall schedule and priorities for sites currently in the surplus inventory. This plan provides for completion of decommissioning of the current inventory by the early 2000's. Priorities are established formally through analysis of health/safety, legal, economic, and work continuity considerations for each site and work plans are developed based on these priorities. The Richland Operations Office is the lead field office in implementing the program.

Specific FY 1985 activities included:

- Shippingport Station Decommissioning Project (SSDP), PA: Completed Operations and Maintenance phase of contract with the start of Decommissioning phase. Initiated decommissioning operations preparation and conducted contractor readiness review prior to start of physical decontamination and decommissioning (D&D) activities.
- Weldon Spring, MO: Completed radiological characterization of the Weldon Spring Quarry, prepared the Engineering Evaluation of Alternatives Addendum, and issued Request for Proposal (RFP) for a management contractor.
- Niagara Falls Storage Site (NFSS), NY: Prepared preliminary final Environmental Impact Statement (EIS) for site disposition and completed transfer of the higher activity pitchblende residues from the concrete tower, where they were stored, to the waste containment area.
- Mound Laboratory, OH: Completed 72 percent of the Mound D&D activities for contaminated plutonium facilities.
- Santa Susana Field Laboratory, CA: Completed Bldg. 055 plutonium glovebox removal and packaging.
- Monticello, UT: Completed cleanup of 15 vicinity properties (50 percent of properties completed) and completed the draft Environmental Assessment (EA) for the mill site.
- Argonne National Laboratory (ANL) - East, IL: Completed 63 percent of D&D activities for old contaminated facilities.
- Idaho National Engineering Laboratory (INEL), ID: Completed the Special Power Excursion Reactor Test (SPERT) I reactor building decommissioning.

In FY 1986 the following will be accomplished:

- NFSS, NY: Complete interim storage facility and treatment of contaminated water. Complete final EIS and record of decision.
- SSDP, PA: Begin physical decommissioning of the Shippingport Atomic Power Station. Complete removal of plant asbestos.
- Weldon Spring, MO: Complete the draft EIS, and continue conceptual engineering and site characterization at Weldon Spring. Select the contractor to manage cleanup of Weldon Spring.
- Mound Laboratory, OH: Complete 82 percent of the Mound D&D activities including 8 plutonium processing building labs, removal of the Waste Transfer System, and demolition of Bldg. 41 and tanks.
- Monticello, UT: Complete cleanup of 7 additional vicinity properties at Monticello (62 percent complete) and complete the EA for the mill site.

- o ANL-East, IL: Complete D&D of surplus facilities in the East area, and initiate preparation for physical decommissioning of the Experimental Boiling Water Reactor (EBWR).

- o Los Alamos National Laboratory (LANL), NM: Complete Phase I D&D of the Technical Area-2 (TA-2) Water Boiler Reactor and associated facilities.

- o INEL, ID: Complete the SPERT I reactor building final report which completes the SPERT and BORAX ancillaries remedial action.

- o Center for Energy and Environment Research (CEER), PR: Initiate D&D of the CEER Facility near Mayaquez, Puerto Rico.

- o Santa Susana, CA: Complete excavation of the Radioactive Material Disposal Facility (RMDF) septic tank. Complete D&D, waste shipments and final reports for the plutonium processing facility (Bldg. 055).

- o Continue surveillance and maintenance for other surplus DOE facilities.

The FY 1987 budget request of $56,000,000 represents an increase of $16,213,000 above the FY 1986 operating expenses appropriation.

Specific accomplishments planned for FY 1987 include:

- o NFSS, NY: Demobilize contractors. Conduct surveillance and maintenance.

- o SSDP, PA: Continue dismantlement of the Shippingport Atomic Power Station at a pace consistent with the project schedule and complete by May 1990. For additional detail on schedules and activities see the Operating Expense Funded Data Sheet included with this submission.

- o Weldon Spring, MO: Complete the final EIS and record of decision for the Weldon Spring Site. Complete characterization and initiate conceptual engineering for the Weldon Spring Remedial Action Project. Begin demolition of non-radiologically contaminated buildings at the Chemical Plant. For additional detail on schedules and activities see the Operating Expense Funded Data Sheet included with this submission.

- o Mound Laboratory, OH: Complete most of the remaining physical D&D activities at the Advanced Nuclear Systems and Projects Division (ANSPD) areas. For additional detail on schedules and activities see the Operating Expense Funded Data Sheet included with this submission.

- o Monticello, UT: Complete remedial action on 12 vicinity properties and initiate mill site remedial action. For additional detail on schedules and activities see the Operating Expense Funded Data Sheet included with this submission.

- o LANL, NM: Initiate D&D of the TA-52 Ultra High Temperature Reactor Experiment (UHTREX).

- o CEER, PR: Complete physical D&D of the CEER Facility.

Remedial Action and Waste Technology - continued

- o Santa Susana, CA: Continue D&D of the RMDF buildings; continue disposition of NaK and lithium and initiate D&D of the Systems for Nuclear Auxiliary Power (SNAP) 8 Test Facility (Bldg. 059).
- o INEL, ID: Initiate stabilization of the Power Burst Facility (PBF) and remove fuel to dry storage in preparation for delayed future decommissioning. Continue D&D of the BORAX V facility.
- o ANL-East, IL: Initiate D&D of the Experimental Boiling Water Reactor (EBWR).
- o Continue surveillance and maintenance of other surplus DOE facilities.

	FY 1986 Appropriation	FY 1987 Request
Capital Equipment	$ 144	$ 400

The capital equipment funding requested is to purchase test equipment and instrumentation in support of the disposition of a number of surplus DOE facilities. These funds will provide equipment such as atomic absorption spectrophotometers, special remote handling and cutting equipment, shielding devices, radiation survey instruments, air monitoring equipment, and electronic radon monitoring devices. Laboratory analysis equipment will also be purchased for environmental monitoring and sampling during remedial action activities.

E. West Valley Demonstration Project........	$ 61,581	$ 79,000
Operating Expenses	$ 61,581	$ 79,000

The objective of the West Valley Demonstration Project is to demonstrate solidification for disposal of high-level nuclear wastes under the provisions of P.L. 96-368, the "West Valley Demonstration Project Act" enacted in 1980. The project will carry out an integrated production-scale development and demonstration project for treating the alkaline and acidic high-level liquid nuclear wastes at the Western New York Nuclear Service Center, near West Valley, New York. The Center reprocessed nuclear fuel from 1966 to 1972. During that time, approximately 560,000 gallons of alkaline high-level waste (HLW) was generated by this activity and stored in a carbon steel tank located in an underground concrete vault. The alkaline waste is similar to that stored at the Department's Savannah River and Hanford sites in that these wastes also consist of a supernatant liquid and a sludge that has formed on the tank bottom. A smaller amount (about 12,000 gallons) of acidic Thorex waste, stored in a stainless steel tank located in a separate underground concrete vault, will also be treated.

Major activities embodied in the project include: (1) necessary decontamination required to prepare existing facilities and equipment at the Center to accommodate the solidification project; (2) removal of the wastes from the underground storage tanks; (3) development, design, construction, and operation of systems and necessary supporting facilities for the solidification of the wastes; (4) acquisition of containers for the permanent disposal of the solidified waste; (5) temporary storage and transportation of the solidified waste to an appropriate Federal repository for permanent disposal; (6) decontamination and decommissioning (D&D) of the waste tanks, facilities, hardware, and material used in carrying out the project; and (7) disposal of low-level waste (LLW) and transuranic (TRU) wastes produced from project activities.

The project strategy is to demonstrate that current high-level waste solidification technology can be readily and promptly adapted to the particular chemistry of the stored West Valley wastes. The Project will minimize new construction by reusing existing space, facilities, and equipment, where feasible; use straightforward engineering methods and eliminate undue or over-elaborate analyses and design; aggressively pursue opportunities which produce technical, cost and schedule benefits; and accept no shortcuts on safety and environmental protection. The approach will achieve solidification at the earliest time consistent with minimizing total project costs and assuring safety. The technical approach is to utilize the U.S. developed liquid-fed ceramic melter process and a borosilicate glass waste form; to construct and operate a nonradioactive vitrification component test stand consisting of the key components (e.g., feed tank, feed concentrator, slurry fed ceramic melter, canister turntable, first stage of off-gas treatment system, and adjunct systems required for operation) with the objective of verifying component performance of integrated process operations and remote design and operation, supporting final vitrification detailed design, training operators, providing samples for product qualification and finalizing operating and maintenance procedures; and to convert the test stand and components for radioactive operation.

The primary technical objectives during FY 1986 include:

Complete design of sludge mobilization and removal equipment, complete supernatant treatment processing system civil construction and procurement, make significant progress on refurbishment of the Chemical Process Cell and the Equipment Decontamination Room (EDR), and complete modifications to several cells in preparation for installation of a liquid radioactive waste treatment system.

Coordination with the Nuclear Regulatory Commission, and other Federal agencies and the State of New York will continue, so as to keep them informed of project plans and progress and to obtain their advice on project-related matters. The project is also coordinating with ongoing activities being conducted by the Nuclear Waste Treatment Program, Office of Civilian Radioactive Waste Management, international waste treatment programs, and the Savannah River Plant Defense Waste Processing Facility funded by Defense Programs.

An estimate for the post-solidification phase (e.g., final decontamination and decommissioning) will be prepared after coordination with the Nuclear Regulatory Commission and the State of New York and after preparation of appropriate NEPA documents; this estimate is scheduled for completion by 1988. A scoping cost estimate for certain potential plans of action for the post-solidification phase will be available in early 1986.

The FY 1987 budget request of $79,000,000 represents an increase of $17,419,000 above the FY 1986 appropriation. The FY 1987 requested funds will be used to complete procurement of equipment and systems and related construction for processing supernatant; complete procurement and construction of vitrification systems and LLW processing systems. Nonradioactive testing of the component test stand and decontamination of several major cells for reuse by the project will continue and installation in decontaminated plant areas and cells of equipment for HLW interim storage, size reduction, and TRU decontamination will begin. Specifically, the following tasks will be performed:

(1) HLW Solidification: Procure sludge mobilization and removal equipment, make several required penetrations to the roof of tank 8D-2, install removal equipment, and issue equipment operating procedures. Process supernatant beginning in early- to mid-FY 1987; the supernatant represents approximately 90 percent of the volume and 50 percent of the radioactivity contained in the underground storage tanks. Complete a major portion of the radioactive conversion engineering and design for the Component Test Stand (CTS). Complete construction of the CTS shield walls and fabrication and delivery of vitrification process components. Begin construction of the tunnel connecting the CTS and the Chemical Process Cell (CPC) HLW interim storage area and begin installation of utilities. Begin modifications to the CPC in preparation for equipment installation.

(2) Decontamination and Decommissioning: The Project strategy is to conduct clean out of the hot cells on a schedule which matches reuse of the hot cells. Decontamination and painting of the CPC, completed by mid-year FY 1987, will be followed by decontamination of the EDR in the fourth quarter of FY 1987. Availability of these two cells will permit start of modifications to the CPC for interim storage of HLW. Refurbishment of the Fuel Receiving Station will be partially complete, permitting installation of initial size reduction equipment. Survey and start of decontamination of other cells will be consistent with overall cell needs.

(3) Site Operations: Efforts in this area will increase modestly in FY 1987 as additional project systems are brought into productive operation. New efforts are associated with full operation of the CTS and the radwaste treatment system for solidifying LLW into cement. Continuing efforts include operation and maintenance in support of the plant utilities room, cooling tower, warehouse, process plant ventilation system, quality assurance lab, alpha lab, analytical cells, HLW tank farm, sewage treatment plant, existing low-level waste treatment system, air compressors, diesel generator, water treatment plant, process building offices ventilation system, fire pumps, and the environmental, analytical chemical and radiochemical laboratories. Purchases for the year to support overall site operations will include chemicals for water, sewage, and LLW treatment, anticontamination clothing, filters, and operations equipment to support supernatant and sludge treatment.

To support the HLW solidification, decontamination, site operations and LLW/TRU waste handling activities, major efforts are required in the areas of industrial hygiene and safety, quality assurance, procurement/contracts, radiological surveillance, environmental monitoring, laboratory analysis, personal dosimetry, and physical security and safeguards.

(4) Low-Level and Transuranic Waste Handling: Refurbishment of the Fuel Receiving Station will be partially complete and installation of size reduction equipment started. The Cement Solidification Subsystem will be in full operation throughout FY 1987 and the Liquid Waste Treatment Subsystem will be operational by mid FY 1987.

In summary, the West Valley Project will continue an aggressive pace in FY 1987 without compromising the schedule or the dedication to the protection of both workers and the environment. In particular, the Project goals include the following:

- Minimize the Total Project Cost Estimate.
- Maintain the earliest feasible schedule for start of solidification consistent with available funding for equipment procurement and construction.
- Procure sludge removal and mobilization equipment, start waste tank modifications, and start equipment installation.
- Process supernatant beginning in early- to mid-FY 1987.
- Continue nonradioactive testing of the Component Test Stand; complete a major portion of the radioactive conversion engineering and design.
- Begin installation of size reduction/TRU decontamination system.
- Perform hot cell decontamination and modifications as necessary to support the above without significant new construction.

	FY 1986 Appropriation	FY 1987 Request
F. Low-Level Waste..........................	$ 4,570	$ 4,000
Operating Expenses	$ 4,474	$ 4,000

The goal of the Low-Level Waste Program is to facilitate the establishment of a reliable nationwide system for management of civilian low-level radioactive waste (LLW). P.L. 96-573, the "Low-Level Radioactive Waste Policy Act," assigned States the responsibility for assuring disposal capacity for low-level radioactive waste generated within their borders. The formation of regional compacts to satisfy this responsibility was encouraged by the Act. Presently, only three LLW disposal facilities operate in the commercial sector. The United States will exhaust its existing disposal capacity in one or more of these facilities by the early 1990s if the current disposal system is not expanded. It is also recognized that technology exists today to dispose of LLW safely, but continued improvements in specific practices, techniques, information, and procedures will result in a more efficient, safe, and effective system for LLW management and disposal. Additionally, several regional compacts specifically require that disposal facilities employ alternative technologies, other than shallow land burial currently being practiced at the three operating sites, for disposal of low-level waste.

It is assumed that States will have joined regional compacts or decided individually to manage their own LLW in 1986. Beginning in FY 1985 support for compact development was phased down significantly. Since no State or region has identified a new LLW disposal site, and given the 3-5 years required for facility construction and licensing, it is unlikely that a new facility could become operational before 1990. Therefore, DOE assistance will be directed at helping States site new LLW disposal facilities and assisting in the evaluation of appropriate waste treatment and disposal technologies. For the long term, States and/or regional compacts are expected to assume the regional management costs for their disposal sites, general technical improvements, and operation of the overall system through appropriate user fees.

During FY 1986 the LLW Program will focus primarily on meeting the generic technical needs of the States and regions and will provide assistance directly to States and regions to support selection and operation of new LLW disposal facilities. The program will support the continued correction of problems and stabilization efforts at disposal sites no longer in operation and will continue to develop innovative methods for the treatment of LLW. Technology developments being studied for the disposal of DOE low-level waste will be assessed and information transferred to the private sector where appropriate.

In December 1985, Congress passed the "Low-Level Radioactive Waste Policy Amendments Act of 1985." This legislation assigns several new responsibilities to the Department relating to management of civilian low-level waste, assistance to regions and states, and annual reporting to the Congress on how low-level waste is being managed in the U.S.

The FY 1987 budget request of $4,000,000 represents a decrease of $474,000 below the FY 1986 operating expenses appropriation. States and/or compact regions will be expected to assume essentially all of their particular disposal system development costs. At this level of funding the Low-Level Waste Program will continue to provide technical support and assistance to States and regions for the development of new LLW disposal facilities, pending further definition of the Department's role under the 1985 amendments to the Low-Level Waste Policy Act.

	FY 1986 Appropriation	FY 1987 Request
Capital equipment	$ 96	$ 0

The FY 1986 capital equipment funds are required for minor improvements to the computer-based LLW tracking system, and laboratory equipment for experiments to improve shallow land disposal and for other disposal site stabilization studies.

G. Waste Treatment.........................	$ 6,206	$ 0
Operating expenses......................	$ 5,773	$ 0

The goal of the Waste Treatment Program, over the past five years, has been to develop and transfer technologies for the treatment and immobilization of nuclear wastes in forms acceptable for transportation, storage, and disposal. This included identification and characterization of the types of nuclear wastes requiring treatment; developing new waste treatment technologies; evaluating the developed technologies in terms of reliability, efficiency, cost effectiveness, and adequacy in meeting environmental, safety, and health protection requirements; and providing a technical resource for other Departmental waste management programs. Efforts have been focused on determining the long-term reliability and maintainability of a prototypical high-level waste treatment system, on testing and selecting acceptable high-level waste forms for storage or disposal, and on transferring treatment technologies to specific Departmental waste management programs such as the West Valley Demonstration Project.

In FY 1985, a year of testing the first-generation high-level waste vitrification system was completed, including preparations for cooperative testing with the Federal Republic of Germany (FRG) and Japan. A limited effort was begun on developing a second-generation high-level waste form with improved performance properties. Transuranic (TRU) waste treatment technology development efforts included evaluation of alternate TRU waste treatment strategies, conduct of preliminary tests on TRU decontamination techniques and processes and initiation of economic assessment studies of alternative TRU waste treatment systems.

Planned accomplishments in FY 1986 include:

- Complete the second year of the planned 5-year project to determine the operational reliability, safety, and process control flexibility of the ceramic melter system for solidification of high-level radioactive wastes.
- Continue the collaborative program with the FRG and Japan on testing of a radioactive vitrification system.
- Phase out work on development of second-generation HLW forms and TRU waste treatment processes.
- Coordinate waste treatment activities with other DOE programs and ensure that U.S. obligations set forth in exchange agreements with the FRG and Japan are satisfied to the maximum extent possible while maintaining an orderly shutdown of this program.
- Evaluate issues related to transportation and treatment of sodium-contaminated wastes and close out this activity.

In FY 1987, radioactive testing of the HLW vitrification system at the Pacific Northwest Laboratory (PNL) will be terminated and the system shutdown. Reports on research results obtained in FY 1986 will be completed. Commitments to the FRG will be met; the bilateral agreement with Japan on ceramic melter testing may have to be terminated.

	FY 1986 Appropriation	FY 1987 Request
Capital equipment......................	$ 433	$ 0

The FY 1986 equipment funding is required to make improvements in vitrification facility off-gas treatment and monitoring systems, instrumentation for the liquid-fed ceramic melter systems, and to obtain analytical instruments for use in characterizing the produced waste forms. Instrumentation required includes manipulators, sampling and on-line analysis equipment, core drills, and feed chemistry control equipment.

	FY 1986 Appropriation	FY 1987 Request
H. Byproducts Utilization..................	$ 4,811	$ 0
Operating expenses.......................	$ 4,811	$ 0

The goal of the Byproducts Utilization Program, as provided by Congress, is to develop and transfer technology for the beneficial uses of nuclear waste byproducts. Irradiation of food and other agricultural commodities will be emphasized in cooperation with States, other Federal agencies, and private sector organizations. Efforts will be focused on establishing demonstration commodity irradiation facilities in States selected on their nearness to major agricultural commodity production and processing centers. Cooperative funding will be sought from the private sector. Also the program will focus on developing an adequate U.S. based supply of irradiation sources for commodity irradiations.

I. Program Direction........................	$ 1,768	$ 2,300

The Remedial Action and Waste Technology program direction FY 1987 budget request is $2,300,000, an increase of $532,000 above the FY 1986 appropriation. This budget provides for 32 full-time equivalents (FTEs), which is an increase of 2 FTEs above the current FY 1986 level. The budget covers employee salaries, overtime, incentive awards, benefits, and the travel expenses directly related to program accomplishment. The travel expenses include both headquarters and dedicated field office personnel who support the Remedial Action and Waste Technology Program. The budget level requested provides for the normal increased personnel costs over the FY 1986 level, such as within-grade increases, promotions, etc., and allows for some increase in travel expenses consistent with the emphasis placed on decentralized field management of program activities. The distribution of FY 1987 funding is as follows: personnel compensation $1,760,000; benefits $215,000; contractual services and supplies $115,000; travel $200,000; and training $10,000.

The current FY 1986 staffing level of 30 FTEs has been adjusted from the original budget request of 27 FTEs. This reallocation, from other Departmental accounts, reflects realignment of on-board Federal employees who are providing required support to the Remedial Action and Waste Technology Program. Funding to support these positions will be derived from the FY 1986 appropriated level of $1,768,000 and from unobligated prior year program direction carryover.

The FY 1987 request provides for 26 full-time equivalent positions at headquarters, an increase of 1 over FY 1986, to provide overall management of the Remedial Action and Waste Technology Program activities. Responsibilities include developing policy; administration-budget formulation and execution; long range planning; issuing guidance; monitoring and evaluating contractor performance; and providing the link between the Department and other agencies, the Congress, public interest constituencies, and the private sector on Remedial Action and Waste Technology activities. These programs require extensive coordination with other Federal agencies, property owners, State and local governments, the Indian Nations, and other nations. Additionally, the budget provides for 6 full-time equivalent positions at Grand Junction, Colorado, an increase of 1 above the FY 1986 level, to provide on-site management support to the Remedial Action programs being conducted in that region of the country and are essential for effective management of these expanding cleanup activities.

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Remedial Action and Waste Technology

(Tabular dollars in thousands. Narrative material in whole dollars.)

Canonsburg Uranium Mill Tailings Project
Canonsburg, Pennsylvania

Total Estimated Cost (TEC): $43,511,000

Canonsburg Uranium Mill Tailings Project
Canonsburg, Pennsylvania

Total Estimated Cost (TEC): $43,511,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	Cumulative Prior Years	FY 1985 Estimate			FY 1986 Estimate		FY 1987 Estimate	
	Obs.	B/A	Obs.	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):								
Design and construction	$ 15,137	$ 12,119	$ 12,119	$ 12,119	$ 3,113	$ 3,113	$ 0	$ 0
Research and development	5,117	172	172	172	269	269	8	8
Facility operations	0	0	0	0	74	74	52	52
Direct project related support cost	8,178	327	327	327	220	220	157	157
Capital equipment	0	0	0	0	0	0	0	0
Total operating expenses	28,432	12,618	12,618	12,618	3,676	3,676	217	217
Other DOE funding:	0	0	0	0	0	0	0	0
Total DOE funding:	28,432	12,618	12,618	12,618	3,676	3,676	217	217
Non-DOE funding:								
State share	(1,514)	(1,212)	(1,212)	(1,212)	(311)	(311)	0	0
Total Project funding	$ 26,918	$ 11,406	$ 11,406	$ 11,406	$ 3,365	$ 3,365	$ 217	$ 217

Canonsburg Uranium Mill Tailings Project
Canonsburg, Pennsylvania

Total Estimated Cost (TEC): $43,511,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1988 Estimate		FY 1989 Estimate		FY 1990 Estimate	
	B/A	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):						
Design and development	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
Research and development	0	0	0	0	0	0
Facility operations	82	82	87	87	0	0
Direct project related support costs	300	300	287	287	112	112
Capital equipment	0	0	0	0	0	0
Total operating expenses	382	382	374	374	112	112
Other DOE funding:	0	0	0	0	0	0
Total DOE funding:	382	382	374	374	112	112
Non-DOE funding:						
State share	0	0	0	0	0	0
Total Project funding	$ 382	$ 382	$ 374	$ 374	$ 112	$ 112

Canonsburg Uranium Mill Tailings Project
Canonsburg, Pennsylvania

Total Estimated Cost (TEC): $43,511,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1991 Estimate		FY 1992 Estimate		FY 1993 Estimate		Total Cost
	B/A	B/O	B/A	B/O	B/A	B/O	B/A
Operating expenses (DOE):							
Design and construction	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 30,369
Research and development	0	0	0	0	0	0	5,566
Facility operations	61	61	22	22	23	23	401
Direct project related support costs	278	278	171	171	182	182	10,212
Capital equipment	0	0	0	0	0	0	0
Total operating expenses	339	339	193	193	205	205	46,548
Other DOE funding:	0	0	0	0	0	0	0
Total DOE funding:	339	339	193	193	205	205	46,548
Non-DOE funding:							
State share	0	0	0	0	0	0	(3,037)
Total Project funding:	$ 339	$ 339	$ 193	$ 193	$ 205	$ 205	$ 43,511

Canonsburg Uranium Mill Tailings Project
Canonsburg, Pennsylvania

Total Estimated Cost (TEC): $43,511,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

Description, Objective and Justification

The Uranium Mill Tailings Radiation Control Act of 1978, Public Law 95-604, 42 USC 7901 (hereinafter referred to as the "Act"), authorizes the Department of Energy (DOE) to undertake remedial actions at 24 designated inactive uranium processing sites and associated vicinity properties.

The purpose of the remedial actions is to stabilize and control the uranium mill tailings and other residual radioactive materials in a safe and environmentally sound manner in order to minimize radiation health hazards to the public. Pursuant to the Act, the remedial actions undertaken by DOE are to be accomplished:

- With the full participation of the affected states and Indian tribes.
- In accordance with standards issued by the Environmental Protection Agency (EPA).
- With the concurrence of the Nuclear Regulatory Commission (NRC).

Location:

Southwestern Pennsylvania, 20 miles southwest of downtown Pittsburgh, in the Borough of Canonsburg (within the corporate boundaries); the Burrell Township tailings are near Blairsville, 40 miles east of Pittsburgh.

Site Description

Canonsburg was used primarily as a site where radium and uranium were extracted from scrap materials, ores, and concentrates. The original 18.6-acre site will be expanded to 30 acres to include the Georges Pottery property and 5 acres of residential property. The site is bounded by Chartiers Creek and the ConRail Railroad. It is enclosed by the residential communities of Canonsburg, Houston, and Strabane, Pennsylvania. The site has 114 associated vicinity properties.

Canonsburg Uranium Mill Tailings Project
Canonsburg, Pennsylvania

Total Estimated Cost (TEC): $43,511,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(a) Schedule of Planned Activities

The following table presents the primary tasks for activities at the Canonsburg site:

Activity	Start	Complete
Environmental Document	05/81	09/83
Conceptual Design	07/82	11/83
Final Design	05/83	02/84
Vicinity Property Remedial Action	10/82	11/85
Processing Site Remedial Action	10/83	04/86
Surveillance and Maintenance	05/86	NA

(b) Management and Contracting

The Uranium Mill Tailings Remedial Action (UMTRA) Project Office has competitively awarded multi-year contracts for a Technical Assistant Contractor (TAC) and a Remedial Action Contractor (RAC) to support the DOE on UMTRA Project activities. The TAC is responsible for: site characterization; NEPA documentation; conceptual design; technology development; technical and management support; and surveillance and maintenance following completion of remedial actions. The RAC performs: engineering design; remedial action construction management; site health and safety; and quality assurance. Actual construction will be performed by RAC-managed subcontractors.

(c) Prior Year Achievements

FY 1985

Vicinity property remedial action continued with remedial actions completed on a total of approximately 101 vicinity properties. Approximately 90 percent of processing site remedial action was completed.

Total Estimated Cost (TEC): $43,511,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

FY 1986

Complete Burrell vicinity property remedial action. Complete remedial action at remaining vicinity properties and processing site. Complete processing site certification and submit license to the NRC. Initiate surveillance and maintenance activities.

(d) Current Year Achievements (FY 1987)

Continue processing site surveillance and maintenance activities.

(e) Reasons for Increase and Decreases

Reasons for the increase from the FY 1986 Budget Operating Expense Funded Data Sheet (TEC = $41,035,000) are as follows:

(1) An increase in the encapsulation cell quantities of more than 80 percent: $2,451,000
(2) An increase for additional data collection and audit costs: $87,000
(3) A reduction in the estimated cost for surveillance and maintenance: ($155,000)
(4) An increase in the estimated management support costs: $345,000
(5) An increase in state-share payments due to the TEC increase: ($252,000)

Canonsburg Uranium Mill Tailings Project
Canonsburg, Pennsylvania

Total Estimated Cost (TEC): $43,511,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(f) Cost Estimates

The costs shown include design and construction, research and development, and direct project related support costs to stabilize and control the uranium mill tailings and other residual radioactive material at Canonsburg, Pennsylvania.

	Total Cost
Design and construction	$ 30,369
Research and development	5,566
Facility operations	401
Direct project related support costs	10,212
Total DOE Cost	46,548
Non-DOE Costs	(3,037)
Total Estimated Cost	$ 43,511

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Salt Lake City Uranium Mill Tailings Project
Salt Lake City, Utah

Total Estimated Cost (TEC): $89,082,000

Salt Lake City Uranium Mill Tailings Project
Salt Lake City, Utah

Total Estimated Cost (TEC): $89,082,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	Cumulative Prior Years	FY 1985 Estimate			FY 1986 Estimate		FY 1987 Estimate	
	Obs.	B/A	Obs.	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):								
Design and construction	$ 6,367	$ 18,545	$ 18,545	$ 18,545	$ 30,702	$ 30,702	$ 22,805	$ 22,805
Research and development	5,281	839	839	839	81	81	108	108
Facility operations	0	0	0	0	0	0	78	78
Direct project related support cost	5,910	314	314	314	111	111	1,623	1,623
Capital equipment	0	0	0	0	0	0	0	0
Total operating expanses	17,558	19,698	19,698	19,698	30,894	30,894	24,614	24,614
Other DOE funding:	0	0	0	0	0	0	0	0
Total DOE funding:	17,558	19,698	19,698	19,698	30,894	30,894	24,614	24,614
Non-DOE funding:								
State share	(637)	(1,855)	(1,855)	(1,855)	(3,070)	(3,070)	(2,280)	(2,280)
Total Project funding	$ 16,921	$ 17,843	$ 17,843	$ 17,843	$ 27,824	$ 27,824	$ 22,334	$ 22,334

Salt Lake City Uranium Mill Tailings Project
Salt Lake City, Utah

Total Estimated Cost (TEC): $89,082,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1988 Estimate		FY 1989 Estimate		FY 1990 Estimate	
	B/A	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):						
Design and development	$ 3,076	$ 3,076	$ 0	$ 0	$ 0	$ 0
Research and development	35	35	0	0	0	0
Facility operations	72	72	42	42	35	35
Direct project related support costs	349	349	198	198	159	159
Capital equipment	0	0	0	0	0	0
Total operating expenses	3,532	3,532	240	240	194	194
Other DOE funding:	0	0	0	0	0	0
Total DOE funding:	3,532	3,532	240	240	194	194
Non-DOE funding:						
State share	(308)	(308)	0	0	0	0
Total Project funding	$ 3,224	$ 3,224	$ 240	$ 240	$ 194	$ 194

Salt Lake City Uranium Mill Tailings Project
Salt Lake City, Utah

Total Estimated Cost (TEC): $89,082,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1991 Estimate		FY 1992 Estimate		FY 1993 Estimate		Total Cost
	B/A	B/O	B/A	B/O	B/A	B/O	B/A
Operating expenses (DOE):							
Design and construction	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 81,495
Research and development	0	0	0	0	0	0	6,344
Facility operations	0	0	18	18	19	19	264
Direct project related support costs	115	115	170	170	180	180	9,129
Capital equipment	0	0	0	0	0	0	0
Total operating expenses	115	115	188	188	199	199	97,232
Other DOE funding:	0	0	0	0	0	0	0
Total DOE funding:	115	115	188	188	199	199	97,232
Non-DOE funding:							
State share	0	0	0	0	0	0	(8,150)
Total Project funding:	$ 115	$ 115	$ 188	$ 188	$ 199	$ 199	$ 89,082

Salt Lake City Uranium Mill Tailings Project
Salt Lake City, Utah

Total Estimated Cost (TEC): $89,082,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

Description, Objective and Justification

The Uranium Mill Tailings Radiation Control Act of 1978, Public Law 95-604, 42 USC 7901 (hereinafter referred to as the "Act"), authorizes the Department of Energy (DOE) to undertake remedial actions at 24 designated inactive uranium processing sites and associated vicinity properties.

The purpose of the remedial actions is to stabilize and control the uranium mill tailings and other residual radioactive materials in a safe and environmentally sound manner in order to minimize radiation health hazards to the public. Pursuant to the Act, the remedial actions undertaken by DOE are to be accomplished:

- With the full participation of the affected states and Indian tribes.
- In accordance with standards issued by the Environmental Protection Agency (EPA).
- With the concurrence of the Nuclear Regulatory Commission (NRC).

Location:

Four miles southwest of downtown Salt Lake City, Utah.

Site Description

The Vitro site is located in a light industrial area of the city of South Salt Lake. It abuts three sides of an operating sewage treatment plant which is undergoing expansion. The total site covers 128 acres. The tailings were contained in three separate ponds comprising 100 acres. The acreage also includes an ore storage area and the old mill site. Portions of the unstabilized tailings have been covered with sewage sludge. The major buildings have been demolished but a considerable amount of rubble remains on the site. Between 1951 and 1964, 1.7 million tons of uranium ore were processed and from 1954 to 1968, 106,000 tons of vanadium ore were processed on the site.

Salt Lake City Uranium Mill Tailings Project
Salt Lake City, Utah

Total Estimated Cost (TEC): $89,082,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(a) Schedule of Planned Activities

The following table presents the primary tasks for activities at the Salt Lake City site:

Activity	Start	Complete
Environmental Document	04/81	10/84
Conceptual Design	07/82	12/84
Final Design	07/84	12/84
Vicinity Property Remedial Action	03/81	03/87
Processing Site Remedial Action	02/85	03/87
Surveillance and Maintenance	04/87	NA

(b) Management and Contracting

The Uranium Mill Tailings Remedial Action (UMTRA) Project Office has competitively awarded multi-year contracts for a Technical Assistant Contractor (TAC) and a Remedial Action Contractor (RAC) to support the DOE on UMTRA Project activities. However, in Salt Lake City the situation differs in that pursuant to a mutual agreement between the Governor of Utah and the Secretary of DOE, the State of Utah is responsible for remedial action at the processing site and removal of the tailings to Clive, Utah. The construction manager in this instance is the Utah Department of Transportation working in conjunction with the Utah Department of Health. Construction is being performed by a State-managed contractor, the Argee Corporation.

(c) Prior Year Achievements

FY 1985

Vicinity property engineering and remedial action continued with completion of remedial action on a total of 45 properties. Processing site engineering was completed and remedial action was initiated to relocate the contaminated materials to Clive, Utah.

Salt Lake City Uranium Mill Tailings Project
Salt Lake City, Utah

Total Estimated Cost (TEC): $89,082,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

FY 1986

Complete remedial action on 40 vicinity properties and 70 percent of processing site remedial action.

(d) Current Year Achievements (FY 1987)

Complete remainder of vicinity property and processing site remedial action and initiate site certification, licensing by NRC, and surveillance and maintenance activities.

(e) Reasons for Increases and Decreases

Reasons for the decrease from the FY 1986 Budget Operating Expense Funded Data Sheet (TEC = $93,115,000) are as follows:

(1) Contract award at a price less than estimated: ($8,755,000)
(2) Increased cost for radiation and construction safety audits and data collection: $836,000
(3) Increased period for surveillance and maintenance: $138,000
(4) A reduction in the estimated management support costs: ($818,000)
(5) Decreased state-share payments in relation to the TEC decrease: $4,566,000

Salt Lake City Uranium Mill Tailings Project
Salt Lake City, Utah

Total Estimated Cost (TEC): $89,082,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(f) Cost Estimates

The costs shown include design and construction, research and development, and direct project related support costs to stabilize and control the uranium mill tailings and other residual radioactive material at Salt Lake City, Utah.

	Total Cost
Design and construction	$ 81,495
Research and development	6,344
Facility operations	264
Direct project related support costs	9,129
Total DOE Cost	97,232
Non-DOE Costs	(8,150)
Total Estimated Cost	$ 89,082

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Shiprock Uranium Mill Tailings Project
Shiprock, New Mexico

Total Estimated Cost (TEC): $23,798,000

Shiprock Uranium Mill Tailings Project
Shiprock, New Mexico

Total Estimated Cost (TEC): $23,798,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	Cumulative Prior Years	FY 1985 Estimate			FY 1986 Estimate		FY 1987 Estimate	
	Obs.	B/A	Obs	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):								
Design and construction	$ 506	$ 2,193	$ 2,193	$ 2,193	$ 10,599	$ 10,599	$ 3,246	$ 3,246
Research and development	2,961	326	326	326	167	167	162	162
Facility operations	0	0	0	0	0	0	78	78
Direct project related support costs	1,363	258	258	258	149	149	265	265
Capital equipment	0	0	0	0	0	0	0	0
Total operating expenses	4,830	2,777	2,777	2,777	10,915	10,915	3,751	3,751
Other DOE Funding	0	0	0	0	0	0	0	0
Total DOE funding	4,830	2,777	2,777	2,777	10,915	10,915	3,751	3,751
Non-DOE Funding:								
State share	0	0	0	0	0	0	0	0
Total Project funding	$ 4,830	$ 2,777	$ 2,777	$ 2,777	$ 10,915	$ 10,915	$ 3,751	$ 3,751

Shiprock Uranium Mill Tailings Project
Shiprock, New Mexico

Total Estimated Cost (TEC): $23,798,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1988 Estimate		FY 1989 Estimate		FY 1990 Estimate	
	B/A	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):						
Design and construction	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
Research and development	24	24	0	0	0	0
Facility operations	82	82	55	55	55	55
Direct project related support costs	349	349	241	241	206	206
Capital equipment	0	0	0	0	0	0
Total operating expenses	455	455	296	296	261	261
Other DOE funding:	0	0	0	0	0	0
Total DOE funding:	455	455	296	296	261	261
Non-DOE funding:						
State share	0	0	0	0	0	0
Total Project funding	$ 455	$ 455	$ 296	$ 296	$ 261	$ 261

Shiprock Uranium Mill Tailings Project
Shiprock, New Mexico

Total Estimated Cost (TEC): $23,798,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1991 Estimate		FY 1992 Estimate		FY 1993 Estimate		Total Cost
	B/A	B/O	B/A	B/O	B/A	B/O	B/A
Operating expenses (DOE):							
Design and construction	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 16,544
Research and development	0	0	0	0	0	0	3,640
Facility operations	0	0	22	22	23	23	315
Direct project related support costs	115	115	171	171	182	182	3,299
Capital equipment	0	0	0	0	0	0	0
Total operating expenses	115	115	193	193	205	205	23,798
Other DOE funding:	0	0	0	0	0	0	0
Total DOE funding:	115	115	193	193	205	205	23,798
Non-DOE funding:							
State share	0	0	0	0	0	0	0
Total Project funding	$ 115	$ 115	$ 193	$ 193	$ 205	$ 205	$ 23,798

Shiprock Uranium Mill Tailings Project
Shiprock, New Mexico

Total Estimated Cost (TEC): $23,798,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

Description, Objective and Justification

The Uranium Mill Tailings Radiation Control Act of 1978, Public Law 95-604, 42 USC 7901 (hereinafter referred to as the "Act"), authorizes the Department of Energy (DOE) to undertake remedial actions at 24 designated inactive uranium processing sites and associated vicinity properties.

The purpose of the remedial actions is to stabilize and control the uranium mill tailings and other residual radioactive materials in a safe and environmentally sound manner in order to minimize radiation health hazards to the public. Pursuant to the Act, the remedial actions undertaken by DOE are to be accomplished:

- With the full participation of the affected states and Indian tribes.
- In accordance with standards issued by the Environmental Protection Agency (EPA).
- With the concurrence of the Nuclear Regulatory Commission (NRC).

Location:

Northwestern corner of New Mexico, on Navajo Nation land, one mile south-southwest of the town of Shiprock, New Mexico, on the south side of the San Juan River.

Site Description:

The site is in a valley formed by the San Juan River. The tailings site is approximately 75 feet above the river on a bench which drops sharply to the flood plain. From 1954 to 1968 approximately 1.5 million tons of uranium ore were processed at the mill site.

The site consists of 144 acres. The tailings are in two piles, covering 72 acres in depths up to 40 feet. Other areas of the site have been decontaminated. The tailings piles have been partially stabilized by covering with up to 2 feet of rocky soil.

Shiprock Uranium Mill Tailings Project
Shiprock, New Mexico

Total Estimated Cost (TEC): $23,798,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(a) Schedule of Planned Activities

The following table presents the primary tasks for activities at the Shiprock site:

Activity	Start	Complete
Environmental Document	07/81	04/84
Conceptual Design	03/83	06/84
Final Design	05/84	08/85
Vicinity Property Remedial Action	08/84	06/86
Processing Site Remedial Action	10/84	02/87
Surveillance and Maintenance	03/87	NA

(b) Management and Contracting

The Uranium Mill Tailings Remedial Action (UMTRA) Project Office has competitively awarded multi-year contracts for a Technical Assistant Contractor (TAC) and a Remedial Action Contractor (RAC) to support the DOE on UMTRA Project activities. The TAC is responsible for: site characterization; NEPA documentation; conceptual design; technology development; technical and management support; and, surveillance and maintenance following completion of remedial actions. The RAC performs: engineering design; remedial action construction management; site health and safety; and, quality assurance. Actual construction will be performed by RAC-managed subcontractors.

(c) Prior Year Achievements

FY 1985

An Environmental Assessment with finding of no significant impact (FONSI) was completed. Processing site engineering was completed and remedial action initiated. Engineering and remedial action were completed on 14 vicinity properties.

FY 1986

Complete vicinity property and 90 percent of processing site remedial action.

Shiprock Uranium Mill Tailings Project
Shiprock, New Mexico

Total Estimated Cost (TEC): $23,798,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(d) Current Year Achievements (FY 1987)

Complete remainder of processing site remedial action. Complete site certification and licensing by NRC and initiate surveillance and maintenance activities.

(e) Reasons for Increases and Decreases

Reasons for increase from the FY 1986 Budget Operating Expense Funded Data Sheet (TEC=$18,399,000) are as follows:

(1) Refined estimate including the cost of royalty payments for cover material from a Navajo Reservation source: $3,624,000
(2) Increased cost for additional hydrology work on flood plain and increased audits: $703,000
(3) Increased cost for surveillance and maintenance: $123,000
(4) An increase in estimated management support costs: $949,000

(f) Cost Estimate

The costs shown include design and construction, research and development, facility operations, and direct project related support costs to stabilize and control the uranium mill tailings and other residual radioactive material at Shiprock, New Mexico.

	Total Cost
Design and construction	$ 16,544
Research and Development	3,640
Facility Operations	315
Direct Project Related Support Costs	3,299
Total DOE Cost	23,798
Non-DOE Costs	0
Total Estimated Cost	$ 23,798

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Durango Uranium Mill Tailings Project
Durango, Colorado

Total Estimated Cost (TEC): $52,579,000

Durango Uranium Mill Tailings Project
Durango, Colorado

Total Estimated Cost (TEC): $52,579,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	Cumulative Prior Years	FY 1985 Estimate			FY 1986 Estimate		FY 1987 Estimate	
	Obs.	B/A	Obs.	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):								
Design and construction	$ 393	$ 938	$ 938	$ 938	$ 2,075	$ 2,075	$ 15,203	$ 15,203
Research and development	2,877	1,834	1,834	1,834	337	337	149	149
Facility operations	0	0	0	0	0	0	0	0
Direct project related support cost	1,325	476	476	476	197	197	678	678
Capital equipment	0	0	0	0	0	0	0	0
Total operating expenses	4,595	3,248	3,248	3,248	2,609	2,609	16,030	16,030
Other DOE funding:	0	0	0	0	0	0	0	0
Total DOE funding:	4,595	3,248	3,248	3,248	2,609	2,609	16,030	16,030
Non-DOE funding:								
State share	(39)	(94)	(94)	(94)	(207)	(207)	(1,520)	(1,520)
Total Project funding	$ 4,556	$ 3,154	$ 3,154	$ 3,154	$ 2,402	$ 2,402	$ 14,510	$ 14,510

Durango Uranium Mill Tailings Project
Durango, Colorado

Total Estimated Cost (TEC): $52,579,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1988 Estimate		FY 1989 Estimate		FY 1990 Estimate	
	B/A	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):						
Design and construction	$ 17,767	$ 17,767	$ 10,313	$ 10,313	$ 0	$ 0
Research and development	273	273	172	172	146	146
Facility operations	0	0	22	22	85	85
Direct project related support costs	351	351	417	417	432	432
Capital equipment	0	0	0	0	0	0
Total operating expenses	18,391	18,391	10,924	10,924	663	663
Other DOE funding:	0	0	0	0	0	0
Total DOE funding:	18,391	18,391	10,924	10,924	663	663
Non-DOE funding:						
State share	(1,777)	(1,777)	(1,031)	(1,031)	0	0
Total Project funding	$ 16,614	$ 16,614	$ 9,893	$ 9,893	$ 663	$ 663

Durango Uranium Mill Tailings Project
Durango, Colorado

Total Estimated Cost (TEC): $52,579,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1991 Estimate		FY 1992 Estimate		FY 1993 Estimate		Total Cost
	B/A	B/O	B/A	B/O	B/A	B/O	B/A
Operating expenses (DOE):							
Design and construction	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$46,689
Research and development	0	0	0	0	0	0	5,788
Facility operations	74	74	28	28	0	0	209
Direct project related support costs	281	281	196	196	208	208	4,561
Capital equipment	0	0	0	0	0	0	0
Total operating expenses	355	355	224	224	208	208	57,247
Other DOE funding:	0	0	0	0	0	0	0
Total DOE funding:	355	355	224	224	208	208	57,247
Non-DOE funding:							
State share	0	0	0	0	0	0	(4,668)
Total Project funding:	$ 355	$ 355	$ 224	$ 224	$ 208	$ 208	$ 52,579

Durango Uranium Mill Tailings Project
Durango, Colorado

Total Estimated Cost (TEC): $52,579,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

Description, Objective and Justification

The Uranium Mill Tailings Radiation Control Act of 1978, public Law 95-604, 42 USC 7901 (hereinafter referred to as the "Act"), authorizes the Department of Energy (DOE) to undertake remedial actions at 24 designated inactive uranium processing sites and associated vicinity properties.

The purpose of the remedial actions is to stabilize and control the uranium mill tailings and other residual radioactive materials in a safe and environmentally sound manner in order to minimize radiation health hazards to the public. Pursuant to the Act, the remedial actions undertaken by DOE are to be accomplished:

- With the full participation of the affected states and Indian tribes.
- In accordance with standards issued by the Environmental Protection Agency (EPA).
- With the concurrence of the Nuclear Regulatory Commission (NRC).

Location:

Southwest side of Durango, Colorado, on the west bank of the Animas River.

Site Description

The site is located on a bench of old smelter slag and alluvium about 35 feet above the normal water surface of the Animas River. The bench slopes gently up from the river for about 500 feet where it merges with the steep face of Smelter Mountain.

The total site stretches along the river for about 1 mile and covers about 126 acres. The partially stabilized tailings cover about 14 acres, the adjacent mill site about 11 acres. The raffinate pond area at the south end of the site covers about 45 acres. The tailings contain approximately 1.6 million tons of material in two piles. The larger one is 230 feet high and covers about 9 acres.

The smaller pile is about 90 feet and covers about 5 acres. Both piles are deposited against the flanks of Smelter Mountain and have steep side slopes averaging about 1.7:1. The tailings are partially stabilized with about 1 foot of cover on the top and vegetation on the slopes. The original mill buildings have been removed except for the 200 foot chimney, a small office building, and some sheds. The original concrete foundations remain. An area of approximately 40 acres surrounding the pile, primarily north and east, is contaminated with windblown tailings.

Durango Uranium Mill Tailings Project
Durango, Colorado

Total Estimated Cost (TEC): $52,579,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(a) Schedule of Planned Activities

The following table presents the primary tasks for activities at the Durango site:

Activity	Start	Complete
Environmental Document	06/81	12/85
Conceptual Design	10/83	12/85
Final Design	07/85	09/86
Vicinity Property Remedial Action	07/84	10/88
Processing Site Remedial Action	04/87	08/89
Surveillance and Maintenance	09/89	NA

(b) Management and Contracting

The Uranium Mill Tailings Remedial Action (UMTRA) Project Office has competitively awarded multi-year contracts for a Technical Assistant Contractor (TAC) and a Remedial Action Contractor (RAC) to support the DOE on UMTRA Project activities. The TAC is responsible for: site characterization; NEPA documentation; conceptual design; technology development; technical and management support; and, maintenance and surveillance following completion of remedial actions. The RAC performs: engineering design; remedial action construction management; site health and safety; and, quality assurance. Actual construction will be performed by RAC-managed subcontractors.

(c) Prior Year Achievements

FY 1985

Initiated processing site engineering.

FY 1986

Complete environmental impact statement, issue Record of Decision and complete processing site engineering. Complete vicinity property remedial action on 25 properties.

Durango Uranium Mill Tailings Project
Durango, Colorado

Total Estimated Cost (TEC): $52,579,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(d) Current Year Achievements (FY 1987)

Complete remedial action on 45 vicinity properties and initiate processing site remedial action.

(e) Reasons for Increase and Decreases

Reasons for increase from the FY 1986 Budget Operating Expense funded Data Sheet (TEC = $43,365,000) are as follows:

(1) A refined estimate including additional quantities and required haul road: $6,999,000
(2) An increase in the estimated costs for site acquisition, audits, and data collection: $1,649,000
(3) A decrease in the estimated period for surveillance and maintenance: ($108,000)
(4) An increase in the estimated management support costs: $1,159,000
(5) An increase in state-share payments due to the TEC increase: ($485,000)

(f) Cost Estimates

The costs shown include design and construction, research and development, and direct project related support costs to stabilize and control the uranium mill tailings and other residual radioactive material at Durango, Colorado.

	Total Cost
Design and construction	$ 46,689
Research and development	5,788
Facility operations	209
Direct project related support costs	4,561
Total DOE Cost	57,247
Non-DOE Costs	(4,668)
Total Estimated Cost	$ 52,579

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Energy Supply Research and Development
Remedial Action and Waste Technology

(Tabular dollars in thousands. Narrative material in whole dollars.)

Gunnison Uranium Mill Tailings Project
Gunnison, Colorado

Total Estimated Cost (TEC): $32,061,000

Gunnison Uranium Mill Tailings Project
Gunnison, Colorado

Total Estimated Cost (TEC): $32,061,000

(Tabular Dollars in Thousands. Narrative material in whole dollars.)

	Cumulative Prior Years	FY 1985 Estimate			FY 1986 Estimate		FY 1987 Estimate	
	Obs.	B/A	Obs.	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):								
Design and construction	$ 0	$ 22	$ 22	$ 22	$ 0	$ 0	$ 4,353	$ 4,353
Research and development	2,151	936	936	936	909	909	189	189
Facility operations	0	2	2	2	0	0	0	0
Direct project related support costs	757	402	402	402	617	617	255	255
Capital equipment	0	0	0	0	0	0	0	0
Total operating expenses	2,908	1,362	1,362	1,362	1,526	1,526	4,797	4,797
Other DOE funding:	0	0	0	0	0	0	0	0
Total DOE funding:	2,908	1,362	1,362	1,362	1,526	1,526	4,797	4,797
Non-DOE funding:								
State share	0	(2)	(2)	(2)	0	0	(435)	(435)
Total Project Funding:	$ 2,908	$ 1,360	$ 1,360	$ 1,360	$ 1,526	$ 1,526	$ 4,362	$ 4,362

Gunnison Uranium Mill Tailings Project
Gunnison, Colorado

Total Estimated Cost (TEC): $32,061,000

(Tabular Dollars in Thousands. Narrative material in whole dollars.)

	FY 1988 Estimate		FY 1989 Estimate		FY 1990 Estimate	
	B/A	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):						
Design and construction	$ 9,224	$ 9,224	$ 6,484	$ 6,484	$ 0	$ 0
Research and development	208	208	172	172	146	146
Facility operations	0	0	0	0	108	108
Direct project related support costs	3,416	3,416	2,342	2,342	478	478
Capital equipment	0	0	0	0	0	0
Total operating expenses	12,848	12,848	8,998	8,998	732	732
Other DOE funding:	0	0	0	0	0	0
Total DOE funding:	12,848	12,848	8,998	8,998	732	732
Non-DOE funding:						
State share	(922)	(922)	(648)	(648)	0	0
Total Project funding	$ 11,926	$ 11,926	$ 8,350	$ 8,350	$ 732	$ 732

Gunnison Uranium Mill Tailings Project
Gunnison, Colorado

Total Estimated Cost (TEC): $32,061,000

(Tabular Dollars in Thousands. Narrative material in whole dollars.)

	FY 1991 Estimate		FY 1992 Estimate		FY 1993 Estimate		Total Cost
	B/A	B/O	B/A	B/O	B/A	B/O	B/A
Operating expenses (DOE):							
Design and construction	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 20,083
Research and development	0	0	0	0	0	0	4,711
Facility operations	83	83	35	35	37	37	265
Direct project related support costs	284	284	222	222	236	236	9,009
Capital equipment	0	0	0	0	0	0	0
Total operating expenses	367	367	257	257	273	273	34,068
Other DOE funding:	0	0	0	0	0	0	0
Total DOE funding:	367	367	257	257	273	273	34,068
Non-DOE funding:							
State share	0	0	0	0	0	0	(2,007)
Total Project funding	$ 367	$ 367	$ 257	$ 257	$ 273	$ 273	$ 32,061

Gunnison Uranium Mill Tailings Project
Gunnison, Colorado

Total Estimated Cost (TEC): $32,061,000

(Tabular Dollars in Thousands. Narrative material in whole dollars.)

Description, Objective and Justification

The Uranium Mill Tailings Radiation Control Act of 1978, Public Law 95-604, 42 USC 7901 (hereinafter referred to as the "Act"), authorizes the Department of Energy (DOE) to undertake remedial actions at 24 designated inactive uranium processing sites and associated vicinity properties.

The purpose of the remedial actions is to stabilize and control the uranium mill tailings and other residual radioactive materials in a safe and environmentally sound manner in order to minimize radiation health hazards to the public. Pursuant to the Act, the remedial actions undertaken by DOE are to be accomplished:

- With the full participation of the affected states and Indian tribes.
- In accordance with standards issued by the Environmental Protection Agency (EPA).
- With the concurrence of the Nuclear Regulatory Commission (NRC).

Location:

Southwest side of Gunnison, Colorado.

Site Description:

The site is located on alluvium about 0.3 miles from the Gunnison River, 0.3 miles from Tomichi Creek, and about 1.5 miles upstream from their confluence. The total site consists of approximately 61.5 acres, the tailings cover about 35 acres, the mill site and ore storage area covers about 20 acres. The site is surrounded with residential and commercial properties.

Of the original mill structures, the main mill building, water tower, and office remain. The tailings have been partially stabilized with about 6 inches of cover and vegetation. During the period 1958-1962 approximately 540,000 tons of ore were processed at the mill site.

Gunnison Uranium Mill Tailings Project
Gunnison, Colorado

Total Estimated Cost (TEC): $32,061,000

(Tabular Dollars in Thousands. Narrative material in whole dollars.)

(a) Schedule of Planned Activities

The following table presents the primary tasks for activities at the Gunnison site:

Activity	Start	Complete
Environmental Document	04/82	04/87
Conceptual Design	11/82	05/87
Final Design	11/86	11/87
Vicinity Property Remedial Action	04/88	09/88
Processing Site Remedial Action	08/87	09/89
Surveillance and Maintenance	10/89	NA

(b) Management and Contracting

The Uranium Mill Tailings Remedial Action (UMTRA) Project Office has competitively awarded multi-year contracts for a Technical Assistance Contractor (TAC) and a Remedial Action Contractor (RAC) to support the DOE on UMTRA Project activities. The TAC is responsible for: site characterization; NEPA documentation; conceptual design; technology development; technical and management support; and maintenance and surveillance following completion of remedial actions. The RAC performs: engineering design; remedial action construction management; site health and safety; and quality assurance. Actual construction will be performed by RAC-managed subcontractors.

(c) Prior Year Achievements

FY 1985

Continued preparation of environmental assessment and conceptual design.

FY 1986

Continue preparation of environmental assessment and conceptual design.

Gunnison Uranium Mill Tailings Project
Gunnison, Colorado

Total Estimated Cost (TEC): $32,061,000

(Tabular Dollars in Thousands. Narrative material in whole dollars.)

(d) Current Year Achievements (FY 1987)

Complete environmental assessment, processing site engineering, and initiate processing site remedial action.

(e) Reasons for Increases and Decreases

Reasons for the increase from the FY 1986 Budget Request Operating Expense Funded Data Sheet (TEC = $16,657,000) are as follows:

(1) Estimate refinement and extended schedule: $6,281,000
(2) An increase in the cost of data acquisition for alternate sites and site selection: $2,263,000
(3) A decrease in the estimated cost of surveillance and maintenance: ($52,000)
(4) An increase in the estimated management support and contingency estimates: $7,451,000
(5) An increase in state-share payments due to the TEC increase: ($539,000)

(f) Cost Estimate

The costs shown include design and construction, research and development, and direct project related support costs to stabilize and control the uranium mill tailings and other residual radioactive material at Gunnison, Colorado.

	Total Cost
Design and construction	$ 20,083
Research and development	4,711
Facility operations	265
Direct project related support costs	9,009
Total DOE cost	34,068
Non-DOE cost	(2,007)
Total Estimated Cost	$ 32,061

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(Tabular dollars in thousands. Narrative material in whole dollars.)

Grand Junction Uranium Mill Tailings Project
Grand Junction, Colorado

Total Estimated Cost (TEC): $277,749,000

Grand Junction Uranium Mill Tailings Project
Grand Junction, Colorado

Total Estimated Cost (TEC): $277,749,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	Cumulative Prior Years	FY 1985 Estimate			FY 1986 Estimate		FY 1987 Estimate	
	Obs.	B/A	Obs.	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):								
Design and construction	$ 3,186	$ 3,786	$ 3,786	$ 3,786	$ 12,177	$ 12,177	$ 33,562	$ 33,562
Research and development	1,964	4,534	4,534	4,534	6,760	6,760	8,781	8,781
Facility operations	0	2	2	2	0	0	0	0
Direct project related support cost	2,012	486	486	486	1,263	1,263	4,612	4,612
Capital equipment	0	0	0	0	0	0	0	0
Total operating expenses	7,162	8,808	8,808	8,808	20,200	20,200	46,955	46,955
Other DOE funding:	0	0	0	0	0	0	0	0
Total DOE funding:	7,162	8,808	8,808	8,808	20,200	20,200	46,955	46,955
Non-DOE funding:								
State share	(319)	(378)	(378)	(378)	(1,219)	(1,219)	(3,359)	(3,359)
Total Project funding	$ 6,843	$ 8,430	$ 8,430	$ 8,430	$ 18,981	$ 18,981	$ 43,596	$ 43,596

Grand Junction Uranium Mill Tailings Project
Grand Junction, Colorado

Total Estimated Cost (TEC): $277,749,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1988 Estimate		FY 1989 Estimate		FY 1990 Estimate	
	B/A	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):						
Design and construction	$ 52,840	$ 52,840	$ 54,476	$ 54,476	$ 58,456	$ 58,456
Research and development	2,246	2,246	294	294	285	285
Facility operations	0	0	0	0	0	0
Direct project related support costs	4,441	4,441	2,389	2,389	699	699
Capital equipment	0	0	0	0	0	0
Total operating expenses	59,527	59,527	57,159	57,159	59,440	59,440
Other DOE funding:	0	0	0	0	0	0
Total DOE funding:	59,527	59,527	57,159	57,159	59,440	59,440
Non-DOE funding:						
State share	(5,285)	(5,285)	(5,449)	(5,449)	(5,846)	(5,846)
Total Project funding	$ 54,242	$ 54,242	$ 51,710	$ 51,710	$ 53,594	$ 53,594

Grand Junction Uranium Mill Tailings Project
Grand Junction, Colorado

Total Estimated Cost (TEC): $277,749,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1991 Estimate		FY 1992 Estimate		FY 1993 Estimate		Total Cost
	B/A	B/O	B/A	B/O	B/A	B/O	B/A
Operating expenses (DOE):							
Design and construction	$ 41,360	$ 41,360	$ 1,232	$ 1,232	$ 0	$ 0	$261,075
Research and development	288	288	156	156	0	0	25,308
Facility operations	0	0	19	19	36	36	57
Direct project related support costs	713	713	395	395	413	413	17,423
Capital equipment	0	0	0	0	0	0	0
Total operating expenses	42,361	42,361	1,802	1,802	449	449	303,863
Other DOE funding:	0	0	0	0	0	0	0
Total DOE funding:	42,361	42,361	1,802	1,802	449	449	303,863
Non-DOE funding:							
State share	(4,136)	(4,136)	(123)	(123)	0	0	(26,114)
Total Project funding:	$ 38,225	$ 38,225	$ 1,679	$ 1,679	$ 449	$ 449	$277,749

Grand Junction Uranium Mill Tailings Project
Grand Junction, Colorado

Total Estimated Cost (TEC): $277,749,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

Description, Objective and Justification

The Uranium Mill Tailings Radiation Control Act of 1978, Public Law 95-604, 42 USC 7901 (hereinafter referred to as the "Act"), authorizes the Department of Energy (DOE) to undertake remedial actions at 24 designated inactive uranium processing sites and associated vicinity properties.

The purpose of the remedial actions is to stabilize and control the uranium mill tailings and other residual radioactive materials in a safe and environmentally sound manner in order to minimize radiation health hazards to the public. Pursuant to the Act, the remedial actions undertaken by DOE are to be accomplished:

- With the full participation of the affected states and Indian tribes.
- In accordance with standards issued by the Environmental Protection Agency (EPA).
- With the concurrence of the Nuclear Regulatory Commission (NRC).

Location:

South side of Grand Junction, Colorado, on the north bank of the Colorado River near its junction with the Gunnison River; adjacent to the industrial center of the city.

Site Description

The site is located on an alluvial flood plain and is surrounded by industrial developments. The total designated site covers about 105 acres. The tailings cover about 60 acres, the mill site and ore storage covers about 5 acres, and the remaining 40-acre area is the state-owned depository for the Grand Junction Remedial Action Project. There are approximately 1.9 million tons of tailings on the site which have been stabilized with a 6-inch dirt cover. Most of the original mill buildings and other structures have been removed. During the period 1951-1970 approximately 2.2 million tons of uranium ore were processed at the mill site.

Grand Junction Uranium Mill Tailings Project
Grand Junction, Colorado

Total Estimated Cost (TEC): $277,749,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(a) Schedule of Planned Activities

The following table presents the primary tasks for activities at the Grand Junction site:

Activity	Start	Complete
Environmental Document	04/82	08/86
Conceptual Design	01/85	09/86
Final Design	04/86	05/87
Vicinity Property Remedial Action	08/83	09/91
Processing Site Remedial Action	06/87	12/91
Surveillance and Maintenance	01/92	NA

(b) Management and Contracting

The Uranium Mill Tailings Remedial Action (UMTRA) Project Office has competitively awarded multi-year contracts for a Technical Assistance Contractor (TAC) and a Remedial Action Contractor (RAC) to support the DOE on UMTRA Project activities. The TAC is responsible for: site characterization; NEPA documentation; conceptual design; technology development; technical and management support; and, surveillance and maintenance following completion of remedial actions. The RAC performs: engineering design; remedial action construction management; site health and safety; and, quality assurance. Actual construction will be performed by RAC-managed subcontractors.

(c) Prior Year Achievements

FY 1985

Initiated processing site environmental impact statement and conceptual design. Completed 56 vicinity property remedial actions.

Grand Junction Uranium Mill Tailings Project
Grand Junction, Colorado

Total Estimated Cost (TEC): $277,749,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

FY 1986

Complete 160 vicinity properties remedial action. Complete environmental impact statement, issue Record of Decision, and initiate processing site engineering.

(d) Current Year Achievements (FY 1987)

Complete remedial actions at approximately 800 vicinity properties. Complete processing site engineering and initiate remedial action.

(e) Reasons for Increases and Decreases

Reasons for the increase from the FY 1986 Budget Request Operating Expense Funded Data Sheet (TEC = $185,045,000) are as follows:

(1) An increase in costs due to refinement of processing site and improved vicinity property cost estimates: $87,970,0000
(2) An increase in the cost of site characterization, data acquisition, etc., to support relocation: $7,050,000
(3) A decrease in estimated cost for surveillance and maintenance: ($12,000)
(4) An increase in the estimated management support costs: $5,596,000
(5) Increased state-share payments in relation to the TEC increase: ($7,900,000)

Grand Junction Uranium Mill Tailings Project
Grand Junction, Colorado

Total Estimated Cost (TEC): $277,749,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(f) Cost Estimate

The costs shown include design and construction, research and development, and direct project related support costs to stabilize and control the uranium mill tailings and other residual radioactive material at Grand Junction, Colorado.

	Total Cost
Design and construction	$261,075
Research and development	25,308
Facility operations	57
Direct project related support costs	17,423
Total DOE Cost	303,135
Non-DOE Costs	(26,114)
Total Estimated Cost	$277,749

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(Tabular dollars in thousands. Narrative material in whole dollars.)

Rifle Uranium Mill Tailings Project
Rifle, Colorado

Total Estimated Cost (TEC): $57,914,000

Rifle Uranium Mill Tailings Project
Rifle, Colorado

Total Estimated Cost (TEC): $57,914,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	Cumulative Prior Years	FY 1985 Estimate			FY 1986 Estimate		FY 1987 Estimate	
	Obs.	B/A	Obs.	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):								
Design and construction	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 994	$ 994
Research and development	1,508	1,105	1,105	1,105	1,242	1,242	674	674
Facility operations	0	2	2	2	0	0	0	0
Direct project related support cost	562	367	367	367	543	543	431	431
Capital equipment	0	0	0	0	0	0	0	0
Total operating expenses	2,070	1,474	1,474	1,474	1,785	1,785	2,099	2,099
Other DOE funding:	0	0	0	0	0	0	0	0
Total DOE funding:	2,070	1,474	1,474	1,474	1,785	1,785	2,099	2,099
Non-DOE funding:								
State Share	0	0	0	0	0	0	(99)	(99)
Total Project funding	$ 2,070	$ 1,474	$ 1,474	$ 1,474	$ 1,785	$ 1,785	$ 2,000	$ 2,000

Rifle Uranium Mill Tailings Project
Rifle, Colorado

Total Estimated Cost (TEC): $57,914,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1988 Estimate		FY 1989 Estimate		FY 1990 Estimate	
	B/A	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):						
Design and construction	$ 10,503	$ 10,503	$ 22,141	$ 22,141	$ 14,761	$ 14,761
Research and development	451	451	230	230	199	199
Facility operations	0	0	0	0	0	0
Direct project related support costs	447	447	461	461	426	426
Capital equipment	0	0	0	0	0	0
Total operating expenses	11,401	11,401	22,832	22,832	15,386	15,386
Other DOE funding:	0	0	0	0	0	0
Total DOE funding:	11,401	11,401	22,832	22,832	15,386	15,386
Non-DOE funding:						
State share	(1,050)	(1,050)	(2,214)	(2,214)	(1,476)	(1,476)
Total Project funding	$ 10,351	$ 10,351	$ 20,618	$ 20,618	$ 13,910	$ 13,910

Rifle Uranium Mill Tailings Project
Rifle, Colorado

Total Estimated Cost (TEC): $57,914,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1991 Estimate		FY 1992 Estimate		FY 1993 Estimate		Total Cost
	B/A	B/O	B/A	B/O	B/A	B/O	B/A
Operating expenses (DOE):							
Design and construction	$ 4,945	$ 4,945	$ 0	$ 0	$ 0	$ 0	$53,344
Research and development	156	156	0	0	0	0	5,565
Facility operations	52	52	70	70	74	74	198
Direct project related support costs	479	479	206	206	219	219	4,141
Capital equipment	0	0	0	0	0	0	0
Total operating expenses	5,632	5,632	276	276	293	293	63,248
Other DOE funding:	0	0	0	0	0	0	0
Total DOE funding:	5,632	5,632	276	276	293	293	63,248
Non-DOE funding:							
State share	(495)	(495)	0	0	0	0	(5,334)
Total Project funding:	$ 5,137	$ 5,137	$ 276	$ 276	$ 293	$ 293	$ 57,914

Rifle Uranium Mill Tailings Project
Rifle, Colorado

Total Estimated Cost (TEC): $57,914,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

Description, Objective and Justification

The Uranium Mill Tailings Radiation Control Act of 1978, Public Law 95-604, 42 USC 7901 (hereinafter referred to as the "Act"), authorizes the Department of Energy (DOE) to undertake remedial actions at 24 designated inactive uranium processing sites and associated vicinity properties.

The purpose of the remedial actions is to stabilize and control the uranium mill tailings and other residual radioactive materials in a safe and environmentally sound manner in order to minimize radiation health hazards to the public. Pursuant to the Act, the remedial actions undertaken by DOE are to be accomplished:

- With the full participation of the affected states and Indian tribes.
- In accordance with standards issued by the Environmental Protection Agency (EPA).
- With the concurrence of the Nuclear Regulatory Commission (NRC).

Location:

Northwest Colorado, approximately 60 miles east of Grand Junction, on the Colorado River. Old Rifle site is just east-southeast of the city of Rifle; New Rifle site is 1-1/2 miles west-southwest of the city.

Site Description

The New Rifle site is located on alluvium about 10 feet above the normal elevation of the Colorado River. The total site covers about 300 acres. The tailings cover about 32 acres on the west half of the site. There are approximately 2.7 million tons of tailings in a two-tiered pile that is about 70 feet high and has side slopes approaching 1:1 at many points. The tailings were stabilized with mulch, fertilized, and vegetated. The mill remains in standby condition and may not be moved. From 1958-1972 approximately 2.7 million tons of ore were processed at the mill site.

The Old Rifle site is located in a small basin at the base of the cliff that marks the northern edge of the Colorado River floodplain. The site covers about 22 acres of which 11 acres are the mill site and the tailings pile covers the rest. During the years 1924-1932 and 1942-1958 approximately 761,000 tons of uranium ore were processed at the mill site. Approximately 400,000 tons of tailings were removed to the New Rifle site leaving approximately 350,000 tons of tailings at the Old Rifle site. The pile is separated from the Colorado River by a railroad embankment that rises about 10 feet above the base of the pile. There is only a minor amount of demolition.

There are about 20 acres of windblown contamination at the Old Rifle site and about 100 acres of windblown contamination at the New Rifle site.

(a) Schedule of Planned Activities

The following table presents the primary tasks for activities at the Rifle site:

Activity	Start	Complete
Environmental Document	04/82	09/87
Conceptual Design	01/85	10/87
Final Design	11/86	09/87
Vicinity Property Remedial Action	06/88	12/89
Processing Site Remedial Action	05/88	06/91
Surveillance and Maintenance	07/91	NA

(b) Management and Contracting

The Uranium Mill Tailings Remedial Action (UMTRA) Project Office has competitively awarded multi-year contracts for a Technical Assistance Contractor (TAC) and a Remedial Action Contractor (RAC) to support the DOE on UMTRA Project activities. The TAC is responsible for: site characterization; NEPA documentation; conceptual design; technology development; technical and management support; and, surveillance and maintenance following completion of remedial actions. The RAC performs: engineering design; remedial action construction management; site health and safety; and, quality assurance. Actual construction will be performed by RAC-managed subcontractors.

Rifle Uranium Mill Tailings Project
Rifle, Colorado

Total Estimated Cost (TEC): $57,914,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(c) Prior Year Achievements

FY 1985

Initiated conceptual design and continued preparation of environmental documentation.

FY 1986

Continue preparation of conceptual design and environmental documentation.

(d) Current Year Achievements (FY 1987)

Complete environmental impact statement, issue Record of Decision and complete processing site engineering. Initiate vicinity property engineering.

(e) Reasons for Increases and Decreases

Reasons for increase from the FY 1986 Budget Request Operating Expense Funded Data Sheet (TEC = $26,407,000) are as follows:

(1) An increase in processing site remedial action estimated cost due to refinement: $30,164,000
(2) An increase in the cost of site characterization and data acquisition to support relocation: $2,088,000
(3) An increase in the period for surveillance and maintenance: $97,000
(4) An increase in the estimated management support costs: $2,030,000
(5) An increase in state-share payments due to the TEC increase: ($2,872,000)

Rifle Uranium Mill Tailings Project
Rifle, Colorado

Total Estimated Cost (TEC): $57,914,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(f) Cost Estimates

The costs shown include design and construction, research and development, and direct project related support costs to stabilize and control the uranium mill tailings and other residual radioactive material at Rifle, Colorado.

	Total Cost
Design and construction	$ 53,344
Research and development	5,565
Facility operations	198
Direct project related support costs	4,141
Total DOE Cost	63,248
Non-DOE Costs	(5,334)
Total Estimated Cost	$ 57,914

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(Tabular dollars in thousands. Narrative material in whole dollars.)

Riverton Uranium Mill Tailings Project
Riverton, Wyoming

Total Estimated Cost (TEC): $34,256,000

Riverton Uranium Mill Tailings Project
Riverton, Wyoming

Total Estimated Cost (TEC): $34,256,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	Cumulative Prior Years	FY 1985 Estimate			FY 1986 Estimate		FY 1987 Estimate	
	Obs.	B/A	Obs.	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):								
Design and construction	$ 119	$ 1,062	$ 1,062	$ 1,062	$ 188	$ 188	$ 2,597	$ 2,597
Research and development	2,125	663	663	663	33	33	146	146
Facility operations	0	4	4	4	0	0	0	0
Direct project related support cost	837	407	407	407	121	121	409	409
Capital equipment	0	0	0	0	0	0	0	0
Total operating expenses	3,081	2,136,	2,136	2,136	342	342	3,152	3,152
Other DOE funding:	0	0	0	0	0	0	0	0
Total DOE funding:	3,081	2,136	2,136	2,136	342	342	3,152	3,152
Non-DOE funding:								
State share	(12)	(106)	(106)	(106)	(19)	(19)	(260)	(260)
Total Project funding	$ 3,069	$ 2,030	$ 2,030	$ 2,030	$ 323	$ 323	$ 2,892	$ 2,892

Riverton Uranium Mill Tailings Project
Riverton, Wyoming

Total Estimated Cost (TEC): $34,256,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1988 Estimate		FY 1989 Estimate		FY 1990 Estimate	
	B/A	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):						
Design and construction	$ 10,246	$ 10,246	$ 6,811	$ 6,811	$ 0	$ 0
Research and development	192	192	174	174	138	138
Facility operations	0	0	0	0	108	108
Direct project related support costs	5,640	5,640	2,962	2,962	479	479
Capital equipment	0	0	0	0	0	0
Total operating expenses	16,078	16,078	9,947	9,947	725	725
Other DOE funding:	0	0	0	0	0	0
Total DOE funding:	16,078	16,078	9,947	9,947	725	725
Non-DOE funding:						
State share	(1,025)	(1,025)	(681)	(681)	0	0
Total Project funding	$ 15,053	$ 15,053	$ 9,266	$ 9,266	$ 725	$ 725

Riverton Uranium Mill Tailings Project
Riverton, Wyoming

Total Estimated Cost (TEC): $34,256,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1991 Estimate		FY 1992 Estimate		FY 1993 Estimate		Total Cost
	B/A	B/O	B/A	B/O	B/A	B/O	B/A
Operating expenses (DOE):							
Design and construction	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 21,023
Research and development	0	0	0	0	0	0	3,471
Facility operations	84	84	35	35	37	37	268
Direct project related support costs	284	284	222	222	236	236	11,597
Capital equipment	0	0	0	0	0	0	0
Total operating expenses	368	368	257	257	273	273	36,359
Other DOE funding:	0	0	0	0	0	0	0
Total DOE funding:	368	368	257	257	273	273	36,359
Non-DOE funding:							
State share	0	0	0	0	0	0	(2,103)
Total Project funding:	$ 368	$ 368	$ 257	$ 257	$ 273	$ 273	$ 34,256

Riverton Uranium Mill Tailings Project
Riverton, Wyoming

Total Estimated Cost (TEC): $34,256,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

Description, Objective and Justification

The Uranium Mill Tailings Radiation Control Act of 1978, Public Law 95-604, 42 USC 7901 (hereinafter referred to as the "Act"), authorizes the Department of Energy (DOE) to undertake remedial actions at 24 designated inactive uranium processing sites and associated vicinity properties.

The purpose of the remedial actions is to stabilize and control the uranium mill tailings and other residual radioactive materials in a safe and environmentally sound manner in order to minimize radiation health hazards to the public. Pursuant to the Act, the remedial actions undertaken by DOE are to be accomplished:

- With the full participation of the affected states and Indian tribes.
- In accordance with standards issued by the Environmental Protection Agency (EPA).
- With the concurrence of the Nuclear Regulatory Commission (NRC).

Location:

West central Wyoming, approximately 120 miles southeast of Teton National Park, and 2 miles southwest of Riverton, Wyoming.

Site Description

The site is within the Wind River Indian Reservation, but is privately owned. The original sulfuric acid plant is still in operation. Between 1958 and 1963 approximately 900,000 tons of ore were processed at the mill site.

Riverton Uranium Mill Tailings Project
Riverton, Wyoming

Total Estimated Cost (TEC): $34,256,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

The total site covers 173 acres of which 72 acres are covered with tailings, 19 acres are the old mill, 65 acres are contaminated with windblown tailings, and 17 acres are uncontaminated land. Portions of the mill structure have been removed. The partially stabilized tailings exist in a relatively confined area of 72 acres. The site is situated between the Wind River and the Little Wind River approximately 1 mile from their confluence.

(a) Schedule of Planned Activities

The following table presents the primary tasks for activities at the Riverton site:

Activity	Start	Complete
Environmental Document	11/81	03/86
Conceptual Design	10/82	03/86
Final Design	10/85	07/87
Vicinity Property Remedial Action	06/85	08/88
Processing Site Remedial Action	09/87	09/89
Surveillance and Maintenance	10/89	NA

(b) Management and Contracting

The Uranium Mill Tailings Remedial Action (UMTRA) Project Office has competitively awarded multi-year contracts for a Technical Assistance Contractor (TAC) and a Remedial Action Contractor (RAC) to support the DOE on UMTRA Project activities. The TAC is responsible for: site characterization; NEPA documentation; conceptual design; technology development; technical and management support; and, surveillance and maintenance following completion of remedial actions. The RAC performs: engineering design; remedial action construction management; site health and safety; and, quality assurance. Actual construction will be performed by RAC-managed subcontractors.

Riverton Uranium Mill Tailings Project
Riverton, Wyoming

Total Estimated Cost (TEC): $34,256,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(c) Prior Year Achievements

FY 1985

Initiated environmental assessment and processing design and completed remedial action on 13 vicinity properties.

FY 1986

Complete environmental assessment and continue processing site engineering.

(d) Current Year Achievements (FY 1987)

Complete processing site engineering and initiate processing site remedial action.

(e) Reasons for Increase and Decreases

Reasons for increase from the FY 1986 Budget Request Operating Expense Funded Data Sheet (TEC = $20,360,000) are as follows:

(1) Refinement of the construction estimate: $3,435,000
(2) An increase in the cost of data acquisition and NEPA documentation: $1,288,000
(3) A reduction in the cost for surveillance and maintenance: ($173,000)
(4) An increase in the estimated management support and contingency cost estimates: $9,597,000
(5) An increase in state-share payments due to the TEC increase: ($251,000)

Riverton Uranium Mill Tailings Project
Riverton, Wyoming

Total Estimated Cost (TEC): $34,256,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(f) Cost Estimates

The costs shown include design and construction, research and development, and direct project related support costs to stabilize and control the uranium mill tailings and other residual radioactive material at Riverton, Wyoming.

	Total Cost
Design and construction	$ 21,023
Research and development	3,471
Facility operations	268
Direct project related support costs	11,597
Total DOE Cost	36,359
Non-DOE Costs	(2,103)
Total Estimated Cost	$ 34,256

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(Tabular dollars in thousands. Narrative material in whole dollars.)

Tuba City Uranium Mill Tailings Project
Tuba City, Arizona

Total Estimated Cost (TEC): $18,381,000

Tuba City Uranium Mill Tailings Project
Tuba City, Arizona

Total Estimated Cost (TEC): $18,381,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	Cumulative Prior Years	FY 1985 Estimate			FY 1986 Estimate		FY 1987 Estimate	
	Obs.	B/A	Obs.	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):								
Design and construction	$ 13	$ 166	$ 166	$ 166	$ 1,201	$ 1,201	$ 1,340	$ 1,340
Research and development	1,279	1,044	1,044	1,044	455	455	156	156
Facility operations	0	2	2	2	0	0	0	0
Direct project related support cost	463	425	425	425	309	309	2,694	2,694
Capital equipment	0	0	0	0	0	0	0	0
Total operating expenses	1,755	1,637	1,637	1,637	1,965	1,965	4,190	4,190
Other DOE funding:	0	0	0	0	0	0	0	0
Total DOE funding:	1,755	1,637	1,637	1,637	1,965	1,965	4,190	4,190
Non-DOE funding:								
State share	0	0	0	0	0	0	0	0
Total Project funding	$ 1,755	$ 1,637	$ 1,637	$ 1,637	$ 1,965	$ 1,965	$ 4,190	$ 4,190

Tuba City Uranium Mill Tailings Project
Tuba City, Arizona

Total Estimated Cost (TEC): $18,381,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1988 Estimate		FY 1989 Estimate		FY 1990 Estimate	
	B/A	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):						
Design and construction	$ 4,341	$ 4,341	$ 1,530	$ 1,530	$ 0	$ 0
Research and development	172	172	163	163	133	133
Facility operations	0	0	16	16	85	85
Direct project related support costs	759	759	415	415	432	432
Capital equipment	0	0	0	0	0	0
Total operating expenses	5,272	5,272	2,124	2,124	650	650
Other DOE funding:	0	0	0	0	0	0
Total DOE funding:	5,272	5,272	2,124	2,124	650	650
Non-DOE funding:						
State share	0	0	0	0	0	0
Total Project funding	$ 5,272	$ 5,272	$ 2,124	$ 2,124	$ 650	$ 650

Tuba City Uranium Mill Tailings Project
Tuba City, Arizona

Total Estimated Cost (TEC): $18,381,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1991 Estimate		FY 1992 Estimate		FY 1993 Estimate		Total Cost
	B/A	B/O	B/A	B/O	B/A	B/O	B/A
Operating expenses (DOE):							
Design and construction	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 8,591
Research and development	0	0	0	0	0	0	3,402
Facility operations	74	74	28	28	0	0	205
Direct project related support costs	282	282	196	196	208	208	6,183
Capital equipment	0	0	0	0	0	0	0
Total operating expenses	356	356	224	224	208	208	18,381
Other DOE funding:	0	0	0	0	0	0	0
Total DOE funding:	356	356	224	224	208	208	18,381
Non-DOE funding:							
State Share	0	0	0	0	0	0	0
Total Project funding:	$ 356	$ 356	$ 224	$ 224	$ 208	$ 208	$ 18,381

Tuba City Uranium Mill Tailings Project
Tuba City, Arizona

Total Estimated Cost (TEC): $18,381,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

Description, Objective and Justification

The Uranium Mill Tailings Radiation Control Act of 1978, Public Law 95-604, 42 USC 7901 (hereinafter referred to as the "Act"), authorizes the Department of Energy (DOE) to undertake remedial actions at 24 designated inactive uranium processing sites and associated vicinity properties.

The purpose of the remedial actions is to stabilize and control the uranium mill tailings and other residual radioactive materials in a safe and environmentally sound manner in order to minimize radiation health hazards to the public. Pursuant to the Act, the remedial actions undertaken by DOE are to be accomplished.

- With the full participation of the affected states and Indian tribes.
- In accordance with standards issued by the Environmental Protection Agency (EPA).
- With the concurrence of the Nuclear Regulatory Commission (NRC).

Location:

North central Arizona, on Navajo Nation land, 5-1/2 miles east of Tuba City, Coconina County, and 85 miles north of Flagstaff.

Site Description

The site is located on gently sloping terrain approximately 2 miles north of the Moenkopi Wash. The total site consists of approximately 105 acres, of which the mill site occupies approximately 30 acres, and emergency dump ponds occupy 20 acres. The mill building, two other structures, and numerous foundations remain on the site. A mill camp consisting of 26 homes, some of which are still occupied, is adjacent to the site. A large surrounding area (304 acres) is contaminated with windblown tailings.

Tuba City Uranium Mill Tailings Project
Tuba City, Arizona

Total Estimated Cost (TEC): $18,381,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(a) Schedule of Planned Activities

The following table presents the primary tasks for activities at the Tuba City site:

Activity	Start	Complete
Environmental Document	06/81	04/86
Conceptual Design	03/83	08/86
Final Design	08/85	04/86
Vicinity Property Remedial Action	05/87	07/87
Processing Site Remedial Action	12/85	08/89
Surveillance and Maintenance	09/89	NA

(b) Management and Contracting

The Uranium Mill Tailings Remedial Action (UMTRA) Project Office has competitively awarded multi-year contracts for a Technical Assistance Contractor (TAC) and a Remedial Action Contractor (RAC) to support the DOE on UMTRA Project activities. The TAC is responsible for: site characterization; NEPA documentation; conceptual design; technology development; technical and management support; and surveillance and maintenance following completion of remedial actions. The RAC performs: engineering design; remedial action construction management; site health and safety; and quality assurance. Actual construction will be performed by RAC-managed subcontractors.

(c) Prior Year Achievements

FY 1985

Continued preparation of environmental assessment, processing site engineering, and conceptual design.

FY 1986

Complete environmental assessment and processing site engineering, and initiate remedial action.

Tuba City Uranium Mill Tailings Project
Tuba City, Arizona

Total Estimated Cost (TEC): $18,381,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(d) Current Year Achievements (FY 1987)

Complete 30 percent of processing site and 100 percent of vicinity property remedial action.

(e) Reasons for Increase and Decreases

Reasons for increase from the FY 1986 Budget Request Operating Expense Funded Data Sheet (TEC = $15,418,000) are as follows:

(1) A reduction in stabilization-in-place construction cost based on estimate refinement: ($3,604,000)
(2) An increase in the cost of data acquisition, site acquisition, and site characterization: $1,426,000
(3) An increase in the period for surveillance and maintenance due to schedule extension: $79,000
(4) An increase in the estimated management support and contingency cost estimates: $5,062,000

(f) Cost Estimates

The costs shown include design and construction, research and development, and direct project related support costs to stabilize and control the uranium mill tailings and other residual radioactive material at Tuba City, Arizona.

	Total Cost
Design and construction	$ 8,591
Research and development	3,402
Facility operations	205
Direct project related support costs	6,183
Total DOE Cost	18,381
Non-DOE Costs	0
Total Estimated Cost	$ 18,381

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Mexican Hat Uranium Mill Tailings Project
Mexican Hat, Utah

Total Estimated Cost (TEC): $30,668,000

Mexican Hat Uranium Mill Tailings Project
Mexican Hat, Utah

Total Estimated Cost (TEC): $30,668,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	Cumulative Prior Years	FY 1985 Estimate			FY 1986 Estimate		FY 1987 Estimate	
	Obs.	B/A	Obs.	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):								
Design and construction	$ 0	$ 183	$ 183	$ 183	$ 546	$ 546	$ 3,006	$ 3,006
Research and development	1,329	790	790	790	775	775	211	211
Facility operations	0	0	0	0	0	0	0	0
Direct project related support cost	475	367	367	367	522	522	290	290
Capital equipment	0	0	0	0	0	0	0	0
Total operating expanses	1,804	1,340	1,340	1,340	1,843	1,843	3,507	3,507
Other DOE funding:	0	0	0	0	0	0	0	0
Total DOE funding:	1,804	1,340	1,340	1,340	1,843	1,843	3,507	3,507
Non-DOE funding:								
State share	0	0	0	0	0	0	0	0
Total Project funding	$ 1,804	$ 1,340	$ 1,340	$ 1,340	$ 1,843	$ 1,843	$ 3,507	$ 3,507

Mexican Hat Uranium Mill Tailings Project
Mexican Hat, Utah

Total Estimated Cost (TEC): $30,668,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1988 Estimate		FY 1989 Estimate		FY 1990 Estimate	
	B/A	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):						
Design and construction	$ 10,789	$ 10,789	$ 8,053	$ 8,053	$ 0	$ 0
Research and development	223	223	221	221	135	135
Facility operations	0	0	0	0	88	88
Direct project related support costs	448	448	641	641	432	432
Capital equipment	0	0	0	0	0	0
Total operating expenses	11,460	11,460	8,915	8,915	655	655
Other DOE funding:	0	0	0	0	0	0
Total DOE funding:	11,460	11,460	8,915	8,915	655	655
Non-DOE funding:						
State share	0	0	0	0	0	0
Total Project funding	$ 11,460	$ 11,460	$ 8,915	$ 8,915	$ 655	$ 655

Mexican Hat Uranium Mill Tailings Project
Mexican Hat, Utah

Total Estimated Cost (TEC): $30,668,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1991 Estimate		FY 1992 Estimate		FY 1993 Estimate		Total Cost
	B/A	B/O	B/A	B/O	B/A	B/O	B/A
Operating expenses (DOE):							
Design and construction	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 22,577
Research and development	0	0	0	0	0	0	3,684
Facility operations	95	95	100	100	126	126	409
Direct project related support costs	362	362	224	224	237	237	3,998
Capital equipment	0	0	0	0	0	0	0
Total operating expenses	457	457	324	324	363	363	30,668
Other DOE funding:	0	0	0	0	0	0	0
Total DOE funding:	457	457	324	324	363	363	30,668
Non-DOE funding:							
State share	0	0	0	0	0	0	0
Total Project funding:	$ 457	$ 457	$ 324	$ 324	$ 363	$ 363	$ 30,668

Mexican Hat Uranium Mill Tailings Project
Mexican Hat, Utah

Total Estimated Cost (TEC): $30,668,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

Description, Objective and Justification

The Uranium Mill Tailings Radiation Control Act of 1978, public Law 95-604, 42 USC 7901 (hereinafter referred to as the "Act"), authorizes the Department of Energy (DOE) to undertake remedial actions at 24 designated inactive uranium processing sites and associated vicinity properties.

The purpose of the remedial actions is to stabilize and control the uranium mill tailings and other residual radioactive materials in a safe and environmentally sound manner in order to minimize radiation health hazards to the public. Pursuant to the Act, the remedial actions undertaken by DOE are to be accomplished:

- With the full participation of the affected states and Indian tribes.
- In accordance with standards issued by the Environmental Protection Agency (EPA).
- With the concurrence of the Nuclear Regultory Commission (NRC).

Location:

Southeast Utah, on Navajo Nation land (tract now known as "Halchita") 1.5 miles southwest of Mexican Hat, Utah.

Site Description

The site is located on gently sloping land about 1 mile south of the San Juan River. The total site consists of 173 acres. The tailings, located in two piles, cover about 68 acres; the mill site covers 15 acres and approximately 90 on-site acres are contaminated with windblown tailings. The tailings consist of about 1.7 million cy (2.2 million tons). The tailings are not stabilized. Some of the existing structures have been decontaminated and are in use. Between 1957 and 1965 approximately 5,700 tons of uranium concentrate were produced from the 2.2 million tons of ore processed as the mill site.

Mexican Hat Uranium Mill Tailings Project
Mexican Hat, Utah

Total Estimated Cost (TEC): $30,668,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(a) Schedule of Planned Activities

The following table presents the primary tasks for activities at the Mexican Hat site:

Activity	Start	Complete
Environmental Document	06/81	09/86
Conceptual Design	01/83	01/87
Final Design	09/85	06/87
Vicinity Property Remedial Action	10/87	09/88
Processing Site Remedial Action	07/87	09/89
Surveillance and Maintenance	10/89	NA

(b) Management and Contracting

The Uranium Mill Tailings Remedial Action (UMTRA) Project Office has competitively awarded multi-year contracts for a Technical Assistance Contractor (TAC) and a Remedial Action Contractor (RAC) to support the DOE on UMTRA Project activities. The TAC is responsible for: site characterization; NEPA documentation; conceptual design; technology development; technical and management support; and, surveillance and maintenance following completion of remedial actions. The RAC performs: engineering design; remedial action construction management; site health and safety; and, quality assurance. Actual construction will be performed by RAC-managed subcontractors.

(c) Prior Year Achievements

FY 1985

Continued preparation of environmental assessment, processing site engineering and conceptual design.

FY 1986

Complete environmental assessment and processing site engineering.

Mexican Hat Uranium Mill Tailings Project
Mexican Hat, Utah

Total Estimated Cost (TEC): $30,668,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(d) Current Year Achievements (FY 1987)

Initiate processing site remedial action.

(e) Reasons for Increase and Decreases

Reasons for increase from the FY 1986 Budget Request Operating Expense Funded Data Sheet (TEC = $19,058,000) are as follows:

(1) An increase due to refined estimate and cover material cost increases: $6,817,000
(2) An increase in the cost of data acquisition, audit and NEPA costs based on experience to date: $1,718,000
(3) An increase in the cost for surveillance and maintenance: $283,000
(4) An increase in the estimated management support costs: $2,792,000

(f) Cost Estimates

The costs shown include design and construction, research and development, and direct project related support costs to stabilize and control the uranium mill tailings and other residual radioactive material at Mexican Hat, Utah.

	Total Cost
Design and construction	$ 22,577
Research and development	3,684
Facility operations	409
Direct project related support costs	3,998
Total DOE Cost	30,668
Non-DOE Costs	0
Total Estimated Cost	$ 30,668

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(Tabular dollars in thousands. Narrative material in whole dollars.)

Lakeview Uranium Mill Tailings Project
Lakeview, Oregon

Total Estimated Cost (TEC): $20,435,000

Lakeview Uranium Mill Tailings Project
Lakeview, Oregon

Total Estimated Cost (TEC): $20,435,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	Cumulative Prior Years	FY 1985 Estimate			FY 1986 Estimate		FY 1987 Estimate	
	Obs.	B/A	Obs.	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):								
Design and construction	$ 0	$ 296	$ 296	$ 296	$ 5,734	$ 5,734	$ 9,104	$ 9,104
Research and development	1,423	926	926	926	134	134	156	156
Facility operations	0	0	0	0	0	0	0	0
Direct project related support cost	526	447	447	447	120	120	195	195
Capital equipment	0	0	0	0	0	0	0	0
Total operating expenses	1,949	1,669	1,669	1,669	5,988	5,988	9,455	9,455
Other DOE funding:	0	0	0	0	0	0	0	0
Total DOE funding:	1,949	1,669	1,669	1,669	5,988	5,988	9,455	9,455
Non-DOE funding:								
State share	0	(30)	(30)	(30)	(573)	(573)	(910)	(910)
Total Project funding	$ 1,949	$ 1,639	$ 1,639	$ 1,639	$ 5,415	$ 5,415	$ 8,545	$ 8,545

Lakeview Uranium Mill Tailings Project
Lakeview, Oregon

Total Estimated Cost (TEC): $20,435,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1988 Estimate		FY 1989 Estimate		FY 1990 Estimate	
	B/A	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):						
Design and construction	$ 728	$ 728	$ 0	$ 0	$ 0	$ 0
Research and development	173	173	108	108	0	0
Facility operations	17	17	99	99	51	51
Direct project related support costs	350	350	422	422	205	205
Capital equipment	0	0	0	0	0	0
Total operating expenses	1,268	1,268	629	629	256	256
Other DOE funding:	0	0	0	0	0	0
Total DOE funding:	1,268	1,268	629	629	256	256
Non-DOE funding:						
State share	(73)	(73)	0	0	0	0
Total Project funding	$ 1,195	$ 1,195	$ 629	$ 629	$ 256	$ 256

Lakeview Uranium Mill Tailings Project
Lakeview, Oregon

Total Estimated Cost (TEC): $20,435,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1991 Estimate		FY 1992 Estimate		FY 1993 Estimate		Total Cost
	B/A	B/O	B/A	B/O	B/A	B/O	B/A
Operating expenses (DOE):							
Design and construction	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 15,862
Research and development	0	0	0	0	0	0	2,920
Facility operations	74	74	41	41	0	0	282
Direct project related support costs	282	282	199	199	211	211	2,957
Capital equipment	0	0	0	0	0	0	0
Total operating expenses	356	356	240	240	211	211	22,021
Other DOE funding:	0	0	0	0	0	0	0
Total DOE funding:	356	356	240	240	211	211	22,021
Non-DOE funding:							
Share funding	0	0	0	0	0	0	(1,586)
Total Project funding:	$ 356	$ 356	$ 240	$ 240	$ 211	$ 211	$ 20,435

Lakeview Uranium Mill Tailings Project
Lakeview, Oregon

Total Estimated Cost (TEC): $20,435,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

Description, Objective and Justification

The Uranium Mill Tailings Radiation Control Act of 1978, Public Law 95-604, 42 USC 7901 (hereinafter referred to as the "Act"), authorizes the Department of Energy to undertake remedial actions at 24 designated inactive uranium processing sites and associated vicinity properties.

The purpose of the remedial actions is to stabilize and control the uranium mill tailings and other residual radioactive materials in a safe and environmentally sound manner in order to minimize radiation health hazards to the public. Pursuant to the Act, the remedial actions undertaken by DOE are to be accomplished.

- With the full participation of the affected states and Indian tribes.
- In accordance with standards issued by the Environmental Protection Agency (EPA).
- With the concurrence of the Nuclear Regulatory Commission (NRC).

Location:

Ninety-six miles east of Klamath Falls, in south-central Oregon, 16 miles north of the Oregon-California border.

Site Description

The site is located on a relatively level terrain. The total site consists of 258 acres. The tailings cover 30 acres, evaporation ponds cover 64 acres and 8 acres of the site are contaminated with windblown tailings. Only 130,000 tons of ore were processed at the site from 1958 and 1968. The on-site structures and mill site areas have been decontaminated and are in use. Only minor contamination remains on the site. The tailings have been stabilized.

Lakeview Uranium Mill Tailings Project
Lakeview, Oregon

Total Estimated Cost (TEC): $20,435,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(a) Schedule of Planned Activities

The following table presents the primary tasks for activities at the Lakeview site:

Activity	Start	Complete
Environmental Document	07/82	12/85
Conceptual Design	05/84	12/85
Final Design	03/85	05/86
Vicinity Property Remedial Action	04/87	09/87
Processing Site Remedial Action	06/86	12/87
Surveillance and Maintenance	01/88	NA

(b) Management and Contracting

The Uranium Mill Tailings Remedial Action (UMTRA) Project Office has competitively awarded multi-year contracts for a Technical Assistant Contractor (TAC) and a Remedial Action Contractor (RAC) to support the DOE on the UMTRA Project activities. The TAC is responsible for: site characterization; NEPA documentation; conceptual design; technology development; technical and management support; and, surveillance and maintenance following completion of remedial actions. The RAC performs: engineering design; remedial action construction management; site health and safety; and, quality assurance. Actual construction will be performed by RAC-managed subcontractors. A decision has been made to relocate the tailings to a site to be determined and acquired by the State of Oregon.

(c) Prior Year Achievements

FY 1985

Continued preparation of environmental documentation and conceptual design and initiated processing site engineering.

Lakeview Uranium Mill Tailings Project
Lakeview, Oregon

Total Estimated Cost (TEC): $20,435,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

FY 1986

Complete environmental assessment and processing site engineering and initiate processing site remedial action.

(d) Current Year Achievements (FY 1987)

Complete 85 percent processing site and vicinity property remedial action.

(e) Reasons for Increase and Decreases

Reasons for increase from the FY 1986 Budget Request Operating Expense Funded Data Sheet (TEC=$19,476,000) are as follows:

(1) A decrease in construction costs due to refinement of estimates: ($1,751,000)
(2) An increase in data acquisition costs for alternate site evaluation: $747,000
(3) An increase in the period for surveillance and maintenance due to schedule extension: $156,000
(4) An increase in management support and contingency estimates: $1,526,000
(5) A decrease in state-share payments due to the TEC increase: $281,000

Lakeview Uranium Mill Tailings Project
Lakeview, Oregon

Total Estimated Cost (TEC): $20,435,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(f) Cost Estimates

The costs shown include design and construction, research and development, and direct project related support costs to stabilize and control the uranium mill tailings and other residual radioactive material at Lakeview, Oregon.

	Total Cost
Design and construction	$ 15,862
Research and development	2,920
Facility operations	282
Direct project related support costs	2,957
Total DOE Cost	22,021
Non-DOE Costs	(1,586)
Total Estimated Cost	$ 20,435

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(Tabular dollars in thousands. Narrative material in whole dollars.)

Ambrosia Lake Uranium Mill Tailings Project
Ambrosia Lake, New Mexico

Total Estimated Cost (TEC): $24,497,000

Ambrosia Lake Uranium Mill Tailings Project
Ambrosia Lake, New Mexico

Total Estimated Cost (TEC): $24,497,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	Cumulative Prior Years	FY 1985 Estimate			FY 1986 Estimate		FY 1987 Estimate	
	Obs.	B/A	Obs.	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):								
Design and construction	$ 0	$ 158	$ 158	$ 158	$ 971	$ 971	$ 3,148	$ 3,148
Research and development	947	703	703	703	450	450	151	151
Facility operations	0	0	0	0	0	0	0	0
Direct project related support cost	333	347	347	347	342	342	193	193
Capital equipment	0	0	0	0	0	0	0	0
Total operating expenses	1,280	1,208	1,208	1,208	1,763	1,763	3,492	3,492
Other DOE funding:	0	0	0	0	0	0	0	0
Total DOE funding:	1,280	1,208	1,208	1,208	1,763	1,763	3,492	3,492
Non-DOE funding:								
State share	0	(16)	(16)	(16)	(97)	(97)	(315)	(315)
Total Project funding	$ 1,280	$ 1,192	$ 1,192	$ 1,192	$ 1,666	$ 1,666	$ 3,177	$ 3,177

Ambrosia Lake Uranium Mill Tailings Project
Ambrosia Lake, New Mexico

Total Estimated Cost (TEC): $24,497,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1988 Estimate		FY 1989 Estimate		FY 1990 Estimate	
	B/A	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):						
Design and construction	$ 10,824	$ 10,824	$ 5,843	$ 5,804	$ 0	$ 0
Research and development	171	171	137	137	78	78
Facility operations	0	0	0	0	61	61
Direct project related support costs	303	303	373	373	387	387
Capital equipment	0	0	0	0	0	0
Total operating expenses	11,298	11,298	6,353	6,353	526	526
Other DOE funding:	0	0	0	0	0	0
Total DOE funding:	11,298	11,298	6,353	6,353	526	526
Non-DOE funding:						
State share	(1,082)	(1,082)	(584)	(584)	0	0
Total Project funding	$ 10,216	$ 10,216	$ 5,769	$ 5,769	$ 526	$ 526

Ambrosia Lake Uranium Mill Tailings Project
Ambrosia Lake, New Mexico

Total Estimated Cost (TEC): $24,497,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1991 Estimate		FY 1992 Estimate		FY 1993 Estimate		Total Cost
	B/A	B/O	B/A	B/O	B/A	B/O	B/A
Operating expenses (DOE):							
Design and construction	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 20,944
Research and development	0	0	0	0	0	0	2,637
Facility operations	50	50	16	16	17	17	144
Direct project related support costs	238	238	170	170	180	180	2,866
Capital equipment	0	0	0	0	0	0	0
Total operating expenses	288	288	186	186	197	197	26,591
Other DOE funding:	0	0	0	0	0	0	0
Total DOE funding:	288	288	186	186	197	197	26,591
Non-DOE funding:							
State share	0	0	0	0	0	0	(2,094)
Total Project funding:	$ 288	$ 288	$ 186	$ 186	$ 197	$ 197	$ 24,497

Ambrosia Lake Uranium Mill Tailings Project
Ambrosia Lake, New Mexico

Total Estimated Cost (TEC): $24,497,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

Description, Objective and Justification

The Uranium Mill Tailings Radiation Control Act of 1978, Public Law 95-604, 42 USC 7901 (hereinafter referred to as the "Act"), authorizes the Department of Energy (DOE) to undertake remedial actions at 24 designated inactive uranium processing sites and associated vicinity properties.

The purpose of the remedial actions is to stabilize and control the uranium mill tailings and other residual radioactive materials in a safe and environmentally sound manner in order to minimize radiation health hazards to the public. Pursuant to the Act, the remedial actions undertaken by DOE are to be accomplished:

- With the full participation of the affected states and Indian tribes.
- In accordance with standards issued by the Environmental Protection Agency (EPA).
- With the concurrence of the Nuclear Regulatory Commission (NRC).

Location:

Northwestern New Mexico, 20 miles north of Grants, 85 miles northwest of Albuquerque.

Site Description

The site is located on a relatively flat valley floor, and is surrounded by open lands and numerous active and inactive uranium mines and mills. From 1957 to 1963 approximately 3 million tons of ore were processed at the mill site.

The total site consists of approximately 200 acres. The tailings pile covers 105 acres, the mill site approximately 30 acres, and approximately 65 acres on the site are covered with windblown tailings. The tailings pile contains 2.5 million tons of tailings. Much of the original mill building and equipment remains intact. Approximately 330 acres of surrounding off-site terrain are contaminated with windblown tailings.

Ambrosia Lake Uranium Mill Tailings Project
Ambrosia Lake, New Mexico

Total Estimated Cost (TEC): $24,497,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(a) Schedule of Planned Activities

The following table presents the primary tasks for activities at the Ambrosia Lake site:

Activity	Start	Complete
Environmental Document	07/81	06/86
Conceptual Design	01/85	07/86
Final Design	12/85	09/86
Vicinity Property Remedial Action	NA	NA
Processing Site Remedial Action	10/86	09/89
Surveillance and Maintenance	10/89	NA

(b) Management and Contracting

The Uranium Mill Tailings Remedial Action (UMTRA) Project Office has competitively awarded multi-year contracts for a Technical Assistant Contractor (TAC) and a Remedial Action Contractor (RAC) to support the DOE on UMTRA Project activities. The TAC is responsible for: site characterization; NEPA documentation; conceptual design; technology development; technical and management support; and surveillance and maintenance following completion of remedial actions. The RAC performs: engineering design; remedial action construction management; site health and safety; and quality assurance. Actual construction will be performed by RAC-managed subcontractors.

(c) Prior Year Achievements

FY 1985

Prepared environmental assessment and site conceptual design.

FY 1986

Complete environmental assessment and complete processing site engineering.

Ambrosia Lake Uranium Mill Tailings Project
Ambrosia Lake, New Mexico

Total Estimated Cost (TEC): $24,497,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(d) Current Year Achievements (FY 1987)

Initiate processing site remedial action.

(e) Reasons for Increase and Decreases

Reasons for increase from the FY 1986 Budget Request Operating Expense Funded Data Sheet (TEC=$21,971,000) are as follows:

(1) An increase in construction costs due to estimate refinement and schedule extension: $106,000
(2) An increase in the cost of data acquisition and NEPA documentation based on experience to date: $836,000
(3) An increase in the estimated cost for surveillance and maintenance due to schedule extension: $54,000
(4) An increase in the estimated management support and contingency estimates: $1,402,000
(5) Decreased state-share payments in relation to the TEC increase: $128,000

(f) Cost Estimate

The costs shown include design and construction, research and development, and direct project related support costs to stabilize and control the uranium mill tailings and other residual radioactive material at Ambrosia Lake, New Mexico.

	Total Cost
Design and construction	$ 20,944
Research and development	2,637
Facility operations	144
Direct project related support costs	2,866
Total DOE Cost	26,591
Non-DOE Costs	(2,094)
Total Estimated Cost	$ 24,497

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(Tabular dollars in thousands. Narrative material in whole dollars.)

Naturita Uranium Mill Tailings Project
Naturita, Colorado

Total Estimated Cost (TEC): $18,702,000

Naturita Uranium Mill Tailings Project
Naturita, Colorado

Total Estimated Cost (TEC): $18,702,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	Cumulative Prior Years	FY 1985 Estimate			FY 1986 Estimate		FY 1987 Estimate	
	Obs.	B/A	Obs.	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):								
Design and construction	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 130	$ 130
Research and development	947	646	646	646	1,406	1,406	873	873
Facility operations	0	0	0	0	0	0	0	0
Direct project related support cost	333	332	332	332	895	895	1,144	1,144
Capital equipment	0	0	0	0	0	0	0	0
Total operating expenses	1,280	978	978	978	2,301	2,301	2,147	2,147
Other DOE funding:	0	0	0	0	0	0	0	0
Total DOE funding:	1,280	978	978	978	2,301	2,301	2,147	2,147
Non-DOE funding:								
State share	0	0	0	0	0	0	(13)	(13)
Total Project funding	$ 1,280	$ 978	$ 978	$ 978	$ 2,301	$ 2,301	$ 2,134	$ 2,134

Naturita Uranium Mill Tailings Project
Naturita, Colorado

Total Estimated Cost (TEC): $18,702,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1988 Estimate		FY 1989 Estimate		FY 1990 Estimate	
	B/A	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):						
Design and construction	$ 315	$ 315	$ 367	$ 367	$ 3,491	$ 3,491
Research and development	320	320	153	153	180	180
Facility operations	0	0	0	0	0	0
Direct project related support costs	906	906	373	373	557	557
Capital equipment	0	0	0	0	0	0
Total operating expenses	1,541	1,541	893	893	4,228	4,228
Other DOE funding:	0	0	0	0	0	0
Total DOE funding:	1,541	1,541	893	893	4,228	4,228
Non-DOE funding:						
State share	(31)	(31)	(37)	(37)	(349)	(349)
Total Project funding	$ 1,510	$ 1,510	$ 856	$ 856	$ 3,879	$ 3,879

Naturita Uranium Mill Tailings Project
Naturita, Colorado

Total Estimated Cost (TEC): $18,702,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1991 Estimate		FY 1992 Estimate		FY 1993 Estimate		Total Cost
	B/A	B/O	B/A	B/O	B/A	B/O	B/A
Operating expenses (DOE):							
Design and construction	$ 4,284	$ 4,284	$ 0	$ 0	$ 0	$ 0	$ 8,587
Research and development	63	63	82	82	0	0	4,670
Facility operations	86	86	91	91	127	127	304
Direct project related support costs	485	485	473	473	501	501	5,999
Capital equipment	0	0	0	0	0	0	0
Total operating expenses	4,918	4,918	646	646	628	628	19,560
Other DOE funding:	0	0	0	0	0	0	0
Total DOE funding:	4,918	4,918	646	646	628	628	19,560
Non-DOE funding:							
State share	(428)	(428)	0	0	0	0	(858)
Total Project funding:	$ 4,490	$ 4,490	$ 646	$ 646	$ 628	$ 628	$ 18,702

Naturita Uranium Mill Tailings Project
Naturita, Colorado

Total Estimated Cost (TEC): $18,702,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

Description, Objective and Justification

The Uranium Mill Tailings Radiation Control Act of 1978, Public Law 95-604, 42 USC 7901 (hereinafter referred to as the "Act"), authorizes the Department of Energy (DOE) to undertake remedial actions at 24 designated inactive uranium processing sites and associated vicinity properties.

The purpose of the remedial actions is to stabilize and control the uranium tailings and other residual radioactive materials in a safe and environmentally sound manner in order to minimize radiation health hazards to the public. Pursuant to the Act, the remedial actions undertaken by DOE are to be accomplished:

- With the full participation of the affected states and Indian tribes.
- In accordance with standards issued by the Environmental Protection Agency (EPA).
- With the concurrence of the Nuclear Regulatory Commission (NRC).

Location:

Two miles northwest of the town of Naturita, Colorado.

Site Description

The site is located on relatively flat, alluvial river-bottom material immediately adjacent to the San Miguel River.

The total site covers approximately 50 acres. The original tailings pile covered 23 acres and the mill site and ore storage covers approximately 14 acres. Essentially, all of the tailings have been removed for reprocessing. The site is stabilized and residual contamination is relatively minor. Numerous buildings and structures remain on the site. From 1942 to 1963 approximately 704,000 tons of ore were processed at the mill site.

Naturita Uranium Mill Tailings Project
Naturita, Colorado

Total Estimated Cost (TEC): $18,702,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(a) Schedule of Planned Activities

The following table presents the primary tasks for activities at the Naturita site:

Activity	Start	Complete
Environmental Document	07/81	03/87
Conceptual Design	04/86	03/87
Final Design	02/87	01/88
Vicinity Property Remedial Action	04/90	06/91
Processing Site Remedial Action	04/90	06/91
Surveillance and Maintenance	07/91	NA

(b) Management and Contracting

The Uranium Mill Tailings Remedial Action (UMTRA) Project Office has competitively awarded multi-year contracts for a Technical Assistance Contractor (TAC) and a Remedial Action Contractor (RAC) to support the DOE on UMTRA Project activities. The TAC is responsible for: site characterization; NEPA documentation; conceptual design; technology development; technical and management support; and, survillance and maintenance following completion of remedial actions. The RAC performs: engineering design; remedial action construction management; site health and safety; and, quality assurance. Actual construction will be performed by RAC-managed subcontractors.

(c) Prior Year Achievements

FY 1985

Continued preparation of environmental assessment.

Naturita Uranium Mill Tailings Project
Naturita, Colorado

Total Estimated Cost (TEC): $18,702,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

FY 1986

Initiate conceptual design and continue preparation of environmental documentation.

(d) Current Year Achievements (FY 1987)

Complete environmental assessment, complete conceptual design and initiate processing site engineering.

(e) Reasons for Increase and Decreases

Reasons for increase from the FY 1986 Budget Request Operating Expense Funded Data Sheet (TEC = $10,445,000) are as follows:

(1) An increase in estimated construction costs due to estimate refinement and schedule extension: $292,000
(2) An increase in the cost of data acquisition and NEPA documentation, based on experience to date: $2,600,000
(3) An increase in the cost for surveillance and maintenance: $214,000
(4) An increase in the management support and contingency estimates: $5,125,000
(5) A decrease in state-share payments due to the TEC increase: $26,000

(f) Cost Estimates

The costs shown include design and construction, research and development, facility operations, and direct project related support costs to stabilize and control the uranium mill tailings and other residual radioactive material at Naturita, Colorado.

Naturita Uranium Mill Tailings Project
Naturita, Colorado

Total Estimated Cost (TEC): $18,702,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	Total Cost
Design and construction	$ 8,587
Research and development	4,670
Facility operations	304
Direct project related support costs	5,999
Total DOE Cost	19,560
Non-DOE Cost	(858)
Total Estimated Cost	$ 18,702

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(Tabular dollars in thousands. Narrative material in whole dollars.)

Falls City Uranium Mill Tailings Project
Falls City, Texas

Total Estimated Cost (TEC): $33,679,000

Falls City Uranium Mill Tailings Project
Falls City, Texas

Total Estimated Cost (TEC): $33,679,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	Cumulative Prior Years	FY 1985 Estimate			FY 1986 Estimate		FY 1987 Estimate	
	Obs.	B/A	Obs.	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):								
Design and construction	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 415	$ 415
Research and development	1,135	357	357	357	1,985	1,985	370	370
Facility operations	0	0	0	0	0	0	0	0
Direct project related support cost	381	267	267	267	831	831	418	418
Capital equipment	0	0	0	0	0	0	0	0
Total operating expenses	1,516	624	624	624	2,816	2,816	1,203	1,203
Other DOE funding:	0	0	0	0	0	0	0	0
Total DOE funding:	1,516	624	624	624	2,816	2,816	1,203	1,203
Non-DOE funding:								
State share	0	0	0	0	0	0	(41)	(41)
Total Project funding	$ 1,516	$ 624	$ 624	$ 624	$ 2,816	$ 2,816	$ 1,162	$ 1,162

Falls City Uranium Mill Tailings Project
Falls City, Texas

Total Estimated Cost (TEC): $33,679,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1988 Estimate		FY 1989 Estimate		FY 1990 Estimate	
	B/A	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):						
Design and construction	$ 3,134	$ 3,134	$ 9,109	$ 9,109	$ 10,244	$ 10,244
Research and development	209	209	163	163	132	132
Facility operations	0	0	0	0	0	0
Direct project related support costs	398	398	374	374	476	476
Capital equipment	0	0	0	0	0	0
Total operating expenses	3,741	3,741	9,646	9,646	10,852	10,852
Other DOE funding:	0	0	0	0	0	0
Total DOE funding:	3,741	3,741	9,646	9,646	10,852	10,852
Non-DOE funding:						
State share	(313)	(313)	(911)	(911)	(1,024)	(1,024)
Total Project funding	$ 3,428	$ 3,428	$ 8,735	$ 8,735	$ 9,828	$ 9,828

Falls City Uranium Mill Tailings Project
Falls City, Texas

Total Estimated Cost (TEC): $33,679,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1991 Estimate		FY 1992 Estimate		FY 1993 Estimate		Total Cost
	B/A	B/A	B/A	B/O	B/A	B/O	B/A
Operating expenses (DOE):							
Design and construction	$ 5,149	$ 5,149	$ 0	$ 0	$ 0	$ 0	$ 28,051
Research and development	0	0	0	0	0	0	4,351
Facility operations	33	33	79	79	84	84	196
Direct project related support costs	282	282	222	222	236	236	3,885
Capital equipment	0	0	0	0	0	0	0
Total operating expenses	5,464	5,464	301	301	320	320	36,483
Other DOE funding:	0	0	0	0	0	0	0
Total DOE funding:	5,464	5,464	301	301	320	320	36,483
Non-DOE funding:							
State share	(515)	(515)	0	0	0	0	(2,804)
Total Project funding:	$ 4,949	$ 4,949	$ 301	$ 301	$ 320	$ 320	$ 33,679

Falls City Uranium Mill Tailings Project
Falls City, Texas

Total Estimated Cost (TEC): $33,679,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

Description, Objective and Justification

The Uranium Mill Tailings Radiation Control Act of 1978, Public Law 95-604, 42 USC 7901 (hereinafter referred to as the "Act"), authorizes the Department of Energy (DOE) to undertake remedial actions at 24 designated inactive uranium processing sites and associated vicinity properties.

The purpose of the remedial actions is to stabilize and control the uranium mill tailings and other residual radioactive materials in a safe and environmentally sound manner in order to minimize radiation health hazards to the public. Pursuant to the Act, the remedial actions undertaken by DOE are to be accomplished:

- With the full participation of the affected states and Indian tribes.
- In accordance with standards issued by the Environmental Protection Agency (EPA).
- With the concurrence of the Nuclear Regulatory Commission (NRC).

Location:

Southeast Texas, about 46 miles southeast of San Antonio, 10 miles southwest of Falls City.

Site Description

The site is located on gently sloping rolling terrain. The total site covers approximately 1,500 acres. The tailings are in 6 piles covering about 150 acres. Five piles are relatively close together and one pile (No. 3) is relatively remote. The tailings are partially stabilized with approximately 2 feet of cover and vegetation.

The mill site covers approximately 10 acres. Most of the original structures and equipment remain. From 1967 to 1973 approximately 2.5 million tons of ore were processed at the mill site.

Falls City Uranium Mill Tailings Project
Falls City, Texas

Total Estimated Cost (TEC): $33,679,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(a) Schedule of Planned Activities

The following table presents the primary tasks for activities at the Falls City site:

Activity	Start	Complete
Environmental Document	07/82	03/87
Conceptual Design	11/85	02/87
Final Design	13/87	04/88
Vicinity Property Remedial Action	10/88	09/90
Processing Site Remedial Action	10/88	07/91
Surveillance and Maintenance	08/91	NA

(b) Management and Contracting

The Uranium Mill Tailings Remedial Action (UMTRA) Project Office has competitively awarded multi-year contracts for a Technical Assistance Contractor (TAC) and a Remedial Action Contractor (RAC) to support the DOE on UMTRA Project activities. The TAC is responsible for: site characterization; NEPA documentation; conceptual design; technology development; technical and management support; and, surveillance and maintenance following completion of remedial actions. The RAC performs: engineering design; remedial action construction management; site health and safety; and, quality assurance. Actual construction will be performed by RAC-managed subcontractors.

Falls City Uranium Mill Tailings Project
Falls City, Texas

Total Estimated Cost (TEC): $33,679,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(c) Prior Year Achievements

FY 1985

Initiate environmental assessment.

FY 1986

Continue work on remedial action plan conceptual design and environment assessment.

(d) Current Year Achievements (FY 1987)

Complete environmental assessment and initiate processing site engineering.

(e) Reasons for Increase and Decreases

Reasons for increase from the FY 1986 Budget Request Operating Expense Funded Data Sheet (TEC = $20,430,000) are as follows:

(1) An increase in the estimate to reflect potential scope changes and schedule extension: $9,584,000
(2) An increase in the cost of data acquisition and NEPA documentation based on experience to date: $2,112,000
(3) An increase in the cost for surveillance and maintenance due to schedule extension: $143,000
(4) An increase in the estimated management support costs: $2,278,000
(5) Increased state-share payments in relation to the TEC increase: ($868,000)

Falls City Uranium Mill Tailings Project
Falls City, Texas

Total Estimated Cost (TEC): $33,679,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(f) Cost Estimates

The costs shown include design and construction, research and development, and direct project related support costs to stabilize and control the uranium mill tailings and other residual radioactive material at Falls City, Texas.

	Total Cost
Design and construction	$ 28,051
Research and development	4,351
Facility operations	196
Direct project related support costs	3,885
Total DOE Cost	36,483
Non-DOE Costs	(2,804)
Total Estimated Cost	$ 33,679

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(Tabular dollars in thousands. Narrative material in whole dollars.)

Green River Uranium Mill Tailings Project
Green River, Utah

Total Estimated Cost (TEC): $20,034,000

Green River Uranium Mill Tailings Project
Green River, Utah

Total Estimated Cost (TEC): $20,034,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	Cumulative Prior Years	FY 1985 Estimate			FY 1986 Estimate		FY 1987 Estimate	
	Obs.	B/A	Obs.	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):								
Design and construction	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 782	$ 782
Research and development	982	321	321	321	638	638	558	558
Facility operations	0	0	0	0	0	0	0	0
Direct project related support cost	351	257	257	257	430	430	657	657
Capital equipment	0	0	0	0	0	0	0	0
Total operating expenses	1,333	578	578	578	1,068	1,068	1,997	1,997
Other DOE funding:	0	0	0	0	0	0	0	0
Total DOE funding:	1,333	578	578	578	1,068	1,068	1,997	1,997
Non-DOE funding:								
State share	0	0	0	0	0	0	(78)	(78)
Total Project funding	$ 1,333	$ 578	$ 578	$ 578	$ 1,068	$ 1,068	$ 1,919	$ 1,919

Green River Uranium Mill Tailings Project
Green River, Utah

Total Estimated Cost (TEC): $20,034,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1988 Estimate		FY 1989 Estimate		FY 1990 Estimate	
	B/A	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):						
Design and construction	$ 222	$ 222	$ 0	$ 0	$ 98	$ 98
Research and development	92	92	54	54	120	120
Facility operations	0	0	0	0	0	0
Direct project related support costs	254	254	83	83	219	219
Capital equipment	0	0	0	0	0	0
Total operating expenses	568	568	137	137	437	437
Other DOE funding:	0	0	0	0	0	0
Total DOE funding:	568	568	137	137	437	437
Non-DOE funding:						
State share	(22)	(22)	0	0	(10)	(10)
Total Project funding	$ 546	$ 546	$ 137	$ 137	$ 427	$ 427

Green River Uranium Mill Tailings Project
Green River, Utah

Total Estimated Cost (TEC): $20,034,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1991 Estimate		FY 1992 Estimate		FY 1993 Estimate		Total Cost
	B/A	B/O	B/A	B/O	B/A	B/O	B/A
Operating expenses (DOE):							
Design and construction	$ 5,465	$ 5,465	$ 5,248	$ 5,248	$ 0	$ 0	$11,815
Research and development	145	145	156	156	0	0	3,066
Facility operations	0	0	19	19	82	82	101
Direct project related support costs	1,653	1,653	1,915	1,915	414	414	6,233
Capital equipment	0	0	0	0	0	0	0
Total operating expenses	7,263	7,263	7,338	7,338	496	496	21,215
Other DOE funding:	0	0	0	0	0	0	0
Total DOE funding:	7,263	7,263	7,338	7,338	496	496	21,215
Non-DOE funding:							
State share	(546)	(546)	(525)	(525)	0	0	(1,181)
Total Project funding:	$ 6,717	$ 6,717	$ 6,813	$ 6,813	$ 496	$ 496	$ 20,034

Green River Uranium Mill Tailings Project
Green River, Utah

Total Estimated Cost (TEC): $20,034,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

Description, Objective and Justification

The Uranium Mill Tailings Radiation Control Act of 1978, Public Law 95-604, 42 USC 7901 (hereinafter referred to as the "Act"), authorizes the Department of Energy (DOE) to undertake remedial actions at 24 designated active uranium processing sites and associated vicinity properties.

The purpose of the remedial actions is to stabilize and control the uranium mill tailings and other residual radioactive materials in a safe and environmentally sound manner in order to minimize radiation health hazards to the public. Pursuant to the Act, the remedial actions undertaken by DOE are to be accomplished:

- With the full participation of the affected states and Indian tribes.
- In accordance with standards issued by the Environmental Protection Agency (EPA).
- With the concurrence of the Nuclear Regulatory Commission (NRC).

Location:

East-central portion of Utah, one mile southeast of the town of Green River, 70 miles west of Utah-Colorado border. The site is about 0.5 mile from the Green River.

Site Description

The tailings rest on the upper terrace deposits, the alluvium of the flood plain, and upon Mancos Shale bedrock. The pile is next to a tributary of the Green River called Browns Wash. The total site covers approximately 39 acres of which 9 acres are tailings, 11 acres are the mill, 4 acres are contaminated with radium, and 15 acres are covered with windblown tailings. The rectangular pile has been partially stabilized with 6 inches of soil. Some remaining structures will be demolished. From 1958 to 1961 approximately 137,000 tons of ore were processed at the mill site.

Green River Uranium Mill Tailings Project
Green River, Utah

Total Estimated Cost (TEC): $20,034,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(a) Schedule of Planned Activities

The following table presents the primary tasks for activities at the Green River site:

Activity	Start	Complete
Environmental Document	10/82	09/87
Conceptual Design	04/86	08/87
Final Design	01/87	03/88
Vicinity Property Remedial Action	04/91	06/91
Processing Site Remedial Action	04/91	06/92
Surveillance and Maintenance	07/92	NA

(b) Management and Contracting

The Uranium Mill Tailings Remedial Action (UMTRA) Project Office has competitively awarded multi-year contracts for a Technical Assistance Contractor (TAC) and a Remedial Action Contractor (RAC) to support the DOE on UMTRA Project activities. The TAC is responsible for: site characterization; NEPA documentation; conceptual design; technology development; technical and management support; and surveillance and maintenance following completion of remedial actions. The RAC performs: engineering design; remedial action construction management; site health and safety; and quality assurance. Actual construction will be performed by RAC-managed subcontractors.

(c) Prior Year Achievements

FY 1985

Initiated preparation of environmental assessment.

FY 1986

Continue preparation of environmental assessment.

Green River Uranium Mill Tailings Project
Green River, Utah

Total Estimated Cost (TEC): $20,034,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(d) Current Year Achievements (FY 1987)

Complete environmental assessment and initiate processing site engineering.

(e) Reasons for Increase and Decreases

Reasons for increase from the FY 1986 Budget Request Operating Expense Funded Data Sheet (TEC = $9,879,000) are as follows:

(1) An increase due to improved construction estimate and schedule extension: $4,348,000
(2) An increase in the estimate for data acquisition and NEPA documentation based on experience to date: $950,000
(3) An increase in the cost for surveillance and maintenance due to schedule extension: $48,000
(4) An increase in the estimated management support and program contingency costs: $5,243,000
(5) An increase in state-share payments due to increase in the TEC: ($434,000)

(f) Cost Estimates

The costs shown include design and construction, research and development, and direct project related support costs to stabilize and control the uranium mill tailings and other residual radioactive material at Green River, Utah.

	Total Cost
Design and construction	$ 11,815
Research and development	3,066
Facility operations	101
Direct project related support costs	6,233
Total DOE Cost	21,215
Non-DOE Costs	(1,181)
Total Estimated Cost	$ 20,034

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Slick Rock Uranium Mill Tailings Project
Slick Rock, Colorado

Total Estimated Cost (TEC): $21,177,000

Slick Rock Uranium Mill Tailings Project
Slick Rock, Colorado

Total Estimated Cost (TEC): $21,177,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	Cumulative Prior Years	FY 1985 Estimate			FY 1986 Estimate		FY 1987 Estimate	
	Obs.	B/A	Obs.	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):								
Design and construction	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 654	$ 654
Research and development	980	331	331	331	154	154	38	38
Facility operations	0	0	0	0	0	0	0	0
Direct project related support costs	351	259	259	259	100	100	105	105
Capital equipment	0	0	0	0	0	0	0	0
Total operating expenses	1,331	590	590	590	254	254	797	797
Other DOE funding:	0	0	0	0	0	0	0	0
Total DOE funding:	1,331	590	590	590	254	254	797	797
Non-DOE funding:								
State share	0	0	0	0	0	0	(65)	(65)
Total Project funding	$ 1,331	$ 590	$ 590	$ 590	$ 254	$ 254	$ 732	$ 732

Slick Rock Uranium Mill Tailings Project
Slick Rock, Colorado

Total Estimated Cost (TEC): $21,177,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1988 Estimate		FY 1989 Estimate		FY 1990 Estimate	
	B/A	B/O	B/A	B/O	B/A	B/O
Operating Expenses (DOE):						
Design and construction	$ 263	$ 263	$ 0	$ 0	$ 98	$ 98
Research and development	2	2	57	57	77	77
Facility operations	0	0	0	0	0	0
Direct project related support costs	108	108	83	83	86	86
Capital equipment	0	0	0	0	0	0
Total operating expenses	373	373	140	140	261	261
Other DOE funding:	0	0	0	0	0	0
Total DOE funding:	373	373	140	140	261	261
Non-DOE funding:						
State share	(26)	(26)	0	0	(10)	(10)
Total Project funding	$ 347	$ 347	$ 140	$ 140	$ 251	$ 251

Slick Rock Uranium Mill Tailings Project
Slick Rock, Colorado

Total Estimated Cost (TEC): $21,177,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1991 Estimate		FY 1992 Estimate		FY 1993 Estimate		Total Cost
	B/A	B/O	B/A	B/O	B/A	B/O	B/A
Operating expenses (DOE):							
Design and construction	$ 4,844	$ 4,844	$ 9,860	$ 9,860	$ 0	$ 0	$15,719
Research and development	86	86	76	76	0	0	1,801
Facility operations	0	0	0	0	0	0	0
Direct project related support costs	1,881	1,881	2,157	2,157	98	98	5,228
Capital equipment	0	0	0	0	0	0	0
Total operating expenses	6,811	6,811	12,093	12,903	98	98	22,748
Other DOE funding:	0	0	0	0	0	0	0
Total DOE funding:	6,811	6,811	12,093	12,093	98	98	22,748
Non-DOE funding:							
State share	(484)	(484)	(986)	(986)	0	0	(1,571)
Total Project funding	$ 6,327	$ 6,327	$ 11,107	$ 11,107	$ 98	$ 98	$ 21,177

Slick Rock Uranium Mill Tailings Project
Slick Rock, Colorado

Total Estimated Cost (TEC): $21,177,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

Description, Objective and Justification

The Uranium Mill Tailings Radiation Control Act of 1978, Public Law 95-604, 42 USC 7901 (hereinafter referred to as the "Act"), authorized the Department of Energy (DOE) to undertake remedial actions at 24 designated inactive uranium processing sites and associated vicinity properties.

The purpose of the remedial actions is to stabilize and control the uranium mill tailings and other residual radioactive materials in a safe and environmentally sound manner in order to minimize radiation health hazards to the public. Pursuant to the Act, the remedial actions undertaken by DOE are to be accomplished:

- With the full participation of the affected states and Indian tribes.
- In accordance with standards issued by the Environmental Protection Agency (EPA).
- With the concurrence of the Nuclear Regulatory Commission (NRC)

Location:

The North Continent (NC) and Union Carbide (UC) sites are in southwest Colorado about 9 miles east of the Utah border and 3 miles northwest of the Post Office at Slick Rock, Colorado. The two sites are about 1 mile apart on the Dolores River.

Site Description:

The sites are located on gently sloping to rough terrain adjacent to the Dolores River. The sites are relatively barren. The two sites combined cover approximately 106 acres. The two tailings piles cover 19 and 6 acres, respectively. The tailings are stabilized with 6 inches of cover. Most of the original structures have been demolished and removed. A gas cleaning facility is presently operating on the western edge of the Union Carbide site. From 1931 to 1957 approximately 37,000 tons of ore were processed at the NC mill site. The UC site was an upgrader plant only and processed about 350,000 tons of ore.

(a) Schedule of Planned Activities

The following table presents the primary tasks for activities at the Slick Rock site:

Activity	Start	Complete
Environmental Document	04/82	08/87
Conceptual Design	07/86	08/87
Final Design	01/87	03/88
Vicinity Property Remedial Action	04/90	09/92
Processing Site Remedial Action	04/91	09/99
Surveillance and Maintenance	10/92	NA

(b) Management and Contracting

The Uranium Mill Tailings Remedial Action (UMTRA) Project Office has competitively awarded multi-year contracts for a Technical Assistance Contractor (TAC) and a Remedial Action Contractor (RAC) to support the DOE on UMTRA Project activities. The TAC is responsible for: site characterization; NEPA documentation; conceptual design; technology development; technical and management support; and, surveillance and maintenance following completion of remedial actions. The RAC performs: engineering design; remedial action construction management; site health and safety; and, quality assurance. Actual construction will be performed by RAC-managed subcontractors.

Slick Rock Uranium Mill Tailings Project
Slick Rock, Colorado

Total Estimated Cost (TEC): $21,177,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(c) Prior Year Achievements

FY 1985

Continued preparation of environmental documentation.

FY 1986

Continue conceptual design and preparation of environmental documentation.

(d) Current Year Achievements (FY 1987)

Complete environmental documentation and conceptual design. Initiate processing site engineering.

(e) Reasons for Increases and Decreases

Reasons for increase from the FY 1986 Budget Request Operating Expense Funded Data Sheet (TEC = $11,359,000) are as follows:

(1) An increase in the construction costs due to estimate refinement and schedule extension: $6,580,000
(2) A decrease in the estimated cost for data acquisition and NEPA documentation: ($293,000)
(3) A decrease in the estimated cost for surveillance and maintenance: ($40,000)
(4) An increase in management support and contingency estimates: $4,182,000
(5) An increase in state-share payments due to the TEC increase: ($611,000)

Slick Rock Uranium Mill Tailings Project
Slick Rock, Colorado

Total Estimated Cost (TEC): $21,177,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(f) Cost Estimate

The costs shown include design and construction, research and development, facility operations, and direct project related support costs to stabilize and control the uranium mill tailings and other residual radioactive material at Slick Rock, Colorado.

	Total Cost
Design and construction	$ 15,719
Research and development	1,801
Facility operations..	0
Direct project related support costs	5,228
Total DOE Cost	$ 22,748
Non-DOE Costs	(1,571)
Total Estimated Cost	$ 21,177
	========

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Belfield/Bowman Uranium Mill Tailings Project
Belfield and Bowman, North Dakota

Total Estimated Cost (TEC): $18,405,000

Belfield/Bowman Uranium Mill Tailings Project
Belfield and Bowman, North Dakota

Total Estimated Cost (TEC): $18,405,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	Cumulative Prior Years	FY 1985 Estimate			FY 1986 Estimate		FY 1987 Estimate	
	Obs.	B/A	Obs.	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):								
Design and construction	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 215	$ 215
Research and development	1,958	242	242	242	1,090	1,090	764	764
Facility operations	0	0	0	0	0	0	0	0
Direct project related support cost	702	424	424	424	405	405	907	907
Capital equipment	0	0	0	0	0	0	0	0
Total operating expenses	2,660	666	666	666	1,495	1,495	1,886	1,886
Other DOE funding:	0	0	0	0	0	0	0	0
Total DOE funding:	2,660	666	666	666	1,495	1,495	1,886	1,886
Non-DOE funding:								
State share	0	0	0	0	0	0	(22)	(22)
Total Project funding	$ 2,660	$ 666	$ 666	$ 666	$ 1,495	$ 1,495	$ 1,864	$ 1,864

Belfield/Bowman Uranium Mill Tailings Project
Belfield and Bowman, North Dakota

Total Estimated Cost (TEC): $18,405,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1988 Estimate		FY 1989 Estimate		FY 1990 Estimate	
	B/A	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):						
Design and construction	$ 153	$ 153	$ 0	$ 0	$ 293	$ 293
Research and development	109	109	109	109	199	199
Facility operations	0	0	0	0	0	0
Direct project related support costs	349	349	83	83	219	219
Capital equipment	0	0	0	0	0	0
Total operating expenses	611	611	192	192	711	711
Other DOE funding:	0	0	0	0	0	0
Total DOE funding:	611	611	192	192	711	711
Non-DOE funding:						
State share	(15)	(15)	0	0	(29)	(29)
Total Project funding	$ 596	$ 596	$ 192	$ 192	$ 682	$ 682

Belfield/Bowman Uranium Mill Tailings Project
Belfield and Bowman, North Dakota

Total Estimated Cost (TEC): $18,405,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1991 Estimate		FY 1992 Estimate		FY 1993 Estimate		Total Cost
	B/A	B/O	B/A	B/O	B/A	B/O	B/A
Operating expenses (DOE):							
Design and construction	$ 3,273	$ 3,273	$ 3,112	$ 3,112	$ 0	$ 0	$ 7,046
Research and development	237	237	230	230	0	0	4,938
Facility operations	0	0	19	19	57	57	76
Direct project related support costs	1,691	1,691	1,886	1,886	383	383	7,049
Capital equipment	0	0	0	0	0	0	0
Total operating expenses	5,201	5,201	5,247	5,427	440	440	19,109
Other DOE funding:	0	0	0	0	0	0	0
Total DOE funding:	5,201	5,201	5,247	5,247	440	440	19,109
Non-DOE funding:							
State share	(327)	(327)	(311)	(311)	0	0	(704)
Total Project funding:	$ 4,874	$ 4,874	$ 4,936	$ 4,936	$ 440	$ 440	$ 18,405

Belfield/Bowman Uranium Mill Tailings Project
Belfield and Bowman, North Dakota

Total Estimated Cost (TEC): $18,405,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

Description, Objective and Justification

The Uranium Mill Tailings Radiation Control Act of 1978, Public Law 95-604, 42 USC 7901 (hereinafter referred to as the "Act"), authorizes the Department of Energy (DOE) to undertake remedial actions at 24 designated inactive uranium processing sites and associated vicinity properties.

The purpose of the remedial actions is to stabilize and control the uranium mill tailings and other residual radioactive materials in a safe and environmentally sound manner in order to minimize radiation health hazards to the public. Pursuant to the Act, the remedial actions undertaken by DOE are to be accomplished:

- With the full participation of the affected states and Indian tribes.
- In accordance with standards issued by the Environmental Protection Agency (EPA).
- With the concurrence of the Nuclear Regulatory Commission (NRC).

Location:

Southwestern North Dakota, one mile southwest of the town of Belfield, Stark

County, and about 19 miles west of Dickinson, North Dakota.

Site Description

The site is nearly level and rests on 6 feet of clay. An intermittent stream passes near the site. No tailings exist because the ore was processed into ash and removed to another site for uranium extraction. Only scattered ash remains at the partially stabilized site. Uranium-bearing lignite coal (60 tons/day), after organic combustion, was shipped to Rifle, Colorado, for processing between 1964 and 1966.

The total site covers 29 acres of which 8 acres are contaminated and 21 acres contain windblown contamination. Some buildings were decontaminated and are in use; however, a few other buildings will be demolished.

Belfield/Bowman Uranium Mill Tailings Project
Belfield and Bowman, North Dakota

Total Estimated Cost (TEC): $18,405,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

BOWMAN SITE

Location:

Southwest corner of North Dakota about seven miles west of Bowman, Bowman County, North Dakota.

Site Description:

The partially stabilized site is on nearly level ground about 1 mile north of Spring Creek. There is no evidence of site erosion and the surrounding land is basically used for grazing. No tailings exist at the site because the ore was processed into ash and hauled to another mill for uranium extraction. Uranium-bearing lignite coal (80-90 tons/day), after organic combustion, was shipped to Ambrosia Lake, New Mexico, for processing between 1963-1967.

The total site contains 12 acres of contaminated ore or ash with an additional 25 acres of contaminated windblown soil off the site. Most of the structures were removed; however, some rubble remains.

(a) Schedule of Planned Activities

The following table presents the primary tasks for activities at the Belfield and Bowman sites:

Activity	Start	Complete
Environmental Document	04/82	09/87
Conceptual Design	11/86	09/87
Final Design	02/87	03/88
Vicinity Property Remedial Action	06/91	09/91

Belfield/Bowman Uranium Mill Tailings Project
Belfield and Bowman, North Dakota

Total Estimated Cost (TEC): $18,405,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

Processing Site Remedial Action	04/91	06/92
Surveillance and Maintenance	07/92	NA

(b) Management and Contracting

The Uranium Mill Tailings Remedial Action (UMTRA) Project Office has competitively awarded multi-year contracts for a Technical Assistance Contractor (TAC) and a Remedial Action Contractor (RAC) to support the DOE on UMTRA Project activities. The TAC is responsible for: site characterization; NEPA documentation; conceptual design; technology development; technical and management support; and, surveillance and maintenance following completion of remedial actions. The RAC performs: engineering design; remedial action construction management; site health and safety; and, quality assurance. Actual construction will be performed by RAC-managed subcontractors.

(c) Prior Year Achievements

FY 1986

Initiate conceptual design and continue development of environmental assessment.

(d) Current Year Achievements (FY 1987)

Complete environmental assessment and initiate processing site engineering.

Belfield/Bowman Uranium Mill Tailings Project
Belfield and Bowman, North Dakota

Total Estimated Cost (TEC): $18,405,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(e) Reasons for Increase and Decreases

Reasons for increase from the FY 1986 Budget Request Operating Expense Funded Data Sheet (TEC = $12,899,000) are as follows:

(1) A decrease in the estimated costs due to merging of the two site remedial actions: ($940,000)
(2) An increase in the estimated cost of data acquisition and NEPA documentation: $877,000
(3) A decrease in the estimated cost for surveillance and maintenance: ($4,000)
(4) An increase in the estimated management support and contingency estimates: $5,448,000
(5) A decrease in state-share payments due to the TEC increase: $125,000

(f) Cost Estimates

The costs shown include design and construction, research and development, and direct project related support costs to stabilize and control the uranium mill tailings and other residual radioactive material at Belfield and Bowman, North Dakota.

	Total Cost
Design and construction	$ 7,046
Research and development	4,938
Facility operations	76
Direct project related support costs	7,049
Total DOE Cost	19,109
Non-DOE Costs	(704)
Total Estimated Cost	$ 18,405

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Maybell Uranium Mill Tailings Project
Maybell, Colorado

Total Estimated Cost (TEC): $21,710,000

Maybell Uranium Mill Tailings Project
Maybell, Colorado

Total Estimated Cost (TEC): $21,710,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	Cumulative Prior Years	FY 1985 Estimate			FY 1986 Estimate		FY 1987 Estimate	
	Obs.	B/A	Obs.	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):								
Design and construction	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 637	$ 637
Research and development	943	244	244	244	572	572	388	388
Facility operations	0	0	0	0	0	0	0	0
Direct project related support cost	333	239	239	239	400	400	527	527
Capital equipment	0	0	0	0	0	0	0	0
Total operating expenses	1,276	483	483	483	972	972	1,552	1,552
Other DOE funding:	0	0	0	0	0	0	0	0
Total DOE funding:	1,276	483	483	483	972	972	1,552	1,552
Non-DOE funding:								
State share	0	0	0	0	0	0	(64)	(64)
Total Project funding	$ 1,276	$ 483	$ 483	$ 483	$ 972	$ 972	$ 1,488	$ 1,488

Maybell Uranium Mill Tailings Project
Maybell, Colorado

Total Estimated Cost (TEC): $21,710,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1988 Estimate		FY 1989 Estimate		FY 1990 Estimate	
	B/A	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):						
Design and construction	$ 0	$ 0	$ 184	$ 184	$ 4,361	$ 4,361
Research and development	60	60	135	135	121	121
Facility operations	0	0	0	0	0	0
Direct project related support costs	108	108	257	257	1,474	1,474
Capital equipment	0	0	0	0	0	0
Total operating expenses	168	168	576	576	5,956	5,956
Other DOE funding:	0	0	0	0	0	0
Total DOE funding:	168	168	576	576	5,956	5,956
Non-DOE funding:						
State share	0	0	(18)	(18)	(436)	(436)
Total Project funding	$ 168	$ 168	$ 558	$ 558	$ 5,520	$ 5,520

Maybell Uranium Mill Tailings Project
Maybell, Colorado

Total Estimated Cost (TEC): $21,710,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1991 Estimate		FY 1992 Estimate		FY 1993 Estimate		Total Cost
	B/A	B/O	B/A	B/O	B/A	B/O	B/A
Operating expenses (DOE):							
Design and construction	$ 8,672	$ 8,672	$ 725	$ 725	$ 0	$ 0	$ 14,579
Research and development	145	145	141	141	0	0	2,749
Facility operations	0	0	19	19	56	56	75
Direct project related support costs	1,733	1,733	337	337	357	357	5,765
Capital equipment	0	0	0	0	0	0	0
Total operating expenses	10,550	10,550	1,222	1,222	413	413	23,168
Other DOE funding:	0	0	0	0	0	0	0
Total DOE funding:	10,550	10,550	1,222	1,222	413	413	23,168
Non-DOE funding:							
State share	(867)	(867)	(73)	(73)	0	0	(1,458)
Total Project funding:	$ 9,683	$ 9,683	$ 1,149	$ 1,149	$ 413	$ 413	$ 21,710

Maybell Uranium Mill Tailings Project
Maybell, Colorado

Total Estimated Cost (TEC): $21,710,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

Description, Objective and Justification

The Uranium Mill Tailings Radiation Control Act of 1978, Public Law 95-604, 42 USC 7901 (hereinafter referred to as the "Act"), authorizes the Department of Energy (DOE) to undertake remedial actions at 24 designated inactive uranium processing sites and associated vicinity properties.

The purpose of the remedial actions is to stabilize and control the uranium mill tailings and other residual radioactive materials in a safe and environmentally sound manner in order to minimize radiation health hazards to the public. Pursuant to the Act, the remedial actions undertaken by DOE are to be accomplished:

- With the full participation of the affected states and Indian tribes.
- In accordance with standards issued by the Environmental Protection Agency (EPA).
- With the concurrence of the Nuclear Regulatory Commission (NRC).

Location:

Northwestern Colorado, 25 miles west of Craig, and 5 miles north of Yampa River.

Site Description

The site is located on gently sloping terrain and is surrounded by numerous open pit uranium mines and overburden piles. The total site covers 110 acres. The tailings cover about 80 acres; the mill site covers approximately 20 acres. An area approximately 50 acres surrounding the site, primarily to the east, is contaminated with windblown tailings.

The tailings are stabilized with 6 inches of cover. The original mill building and other structures have been removed. A heap leach facility is in operation to the west of the tailings. Between 1957 and 1964 approximately 2.6 million tons of ore were processed at the mill site.

Maybell Uranium Mill Tailings Project
Maybell, Colorado

Total Estimated Cost (TEC): $21,710,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(a) Schedule of Planned Activities

The following table presents the primary tasks for activities at the Maybell site:

Activity	Start	Complete
Environmental Document	01/82	09/87
Conceptual Design	06/86	09/87
Final Design	12/86	03/88
Vicinity Property Remedial Action	NA	NA
Processing Remedial Action Site	04/90	06/92
Surveillance and Maintenance	07/92	NA

(b) Management and Contracting

The Uranium Mill Tailings Remedial Action (UMTRA) Project Office has competitively awarded multi-year contracts for a Technical Assistance Contractor (TAC) and a Remedial Action Contractor (RAC) to support the DOE on UMTRA Project activities. The TAC is responsible for: site characterization; NEPA documentation; conceptual design; technology development; technical and management support; and, surveillance and maintenance following completion of remedial actions. The RAC performs: engineering design; remedial action construction management; site health and safety; and, quality assurance. Actual construction will be performed by RAC-managed subcontractors.

Maybell Uranium Mill Tailings Project
Maybell, Colorado

Total Estimated Cost (TEC): $21,710,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(c) Prior Year Achievements

FY 1985

Continued preparation of environmental documentation

FY 1986

Initiate conceptual design and continue environmental documentation effort.

(d) Current Year Achievements (FY 1987)

Complete environmental documentation and initiate processing site engineering.

(e) Reasons for Increases and Decreases

Reasons for increase from the FY 1986 Budget Request Operating Expense Funded Data Sheet (TEC = $13,149,000) are as follows:

(1) An increase in construction costs due to revised estimates and schedule extension: $3,323,000
(2) An increase in the estimated cost of data acquisition and NEPA documentation based on experience: $818,000
(3) An increase in the cost for surveillance and maintenance: $35,000
(4) An increase in management support and contingency estimates: $4,629,000
(5) An increase in state-share payments due to the TEC increase: ($244,000)

Maybell Uranium Mill Tailings Project
Maybell, Colorado

Total Estimated Cost (TEC): $21,710,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(f) Cost Estimate

The costs shown include design and construction, research and development, facility operations, and direct project related support costs to stabilize and control the uranium mill tailings and other residual radioactive material at Maybell, Colorado.

	Total Cost
Design and construction	$ 14,579
Research and development	2,749
Facility operations	75
Direct project related support costs	5,765
Total DOE Cost	23,168
Non-DOE Costs	(1,458)
Total Estimated Cost	$ 21,710

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Lowman Uranium Mill Tailings Project
Lowman, Idaho

Total Estimated Cost (TEC): $11,841,000

Lowman Uranium Mill Tailings Project
Lowman, Idaho

Total Estimated Cost (TEC): $11,841,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	Cumulative Prior Years	FY 1985 Estimate			FY 1986 Estimate		FY 1987 Estimate	
	Obs.	B/A	Obs.	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):								
Design and construction	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 255	$ 255
Research and development	979	151	151	151	413	413	863	863
Facility operations	0	0	0	0	0	0	0	0
Direct project related support cost	351	218	218	218	339	339	693	693
Capital equipment	0	0	0	0	0	0	0	0
Total operating expenses	1,330	369	369	369	752	752	1,811	1,811
Other DOE funding:	0	0	0	0	0	0	0	0
Total DOE funding:	1,330	369	369	369	752	752	1,811	1,811
Non-DOE funding:								
State share	0	0	0	0	0	0	(25)	(25)
Total Project funding	$ 1,330	$ 369	$ 369	$ 369	$ 752	$ 752	$ 1,786	$ 1,786

Lowman Uranium Mill Tailings Project
Lowman, Idaho

Total Estimated Cost (TEC): $11,841,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1988 Estimate		FY 1989 Estimate		FY 1990 Estimate	
	B/A	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):						
Design and construction	$ 90	$ 90	$ 0	$ 0	$ 0	$ 0
Research and development	146	146	58	58	119	119
Facility operations	0	0	0	0	0	0
Direct project related support costs	375	375	110	110	249	249
Capital equipment	0	0	0	0	0	0
Total operating expenses	611	611	168	168	368	368
Other DOE funding:	0	0	0	0	0	0
Total DOE funding:	611	611	168	168	368	368
Non-DOE funding:						
State share	(9)	(9)	0	0	0	0
Total Project funding	$ 602	$ 602	$ 168	$ 168	$ 368	$ 368

Lowman Uranium Mill Tailings Project
Lowman, Idaho

Total Estimated Cost (TEC): $11,841,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1991 Estimate		FY 1992 Estimate		FY 1993 Estimate		Total Cost
	B/A	B/O	B/A	B/O	B/A	B/O	B/A
Operating expenses (DOE):							
Design and construction	$ 207	$ 207	$ 3,881	$ 3,881	$ 0	$ 0	$ 4,433
Research and development	146	146	0	0	0	0	2,875
Facility operations	0	0	0	0	78	78	78
Direct project related support costs	478	478	1,921	1,921	164	164	4,898
Capital equipment	0	0	0	0	0	0	0
Total operating expenses	831	831	5,802	5,802	242	242	12,284
Other DOE funding:	0	0	0	0	0	0	0
Total DOE funding	831	831	5,802	5,802	242	242	12,284
Non-DOE funding:							
State share	(21)	(21)	(388)	(388)	0	0	(443)
Total Project funding:	$ 810	$ 810	$ 5,414	$ 5,414	$ 242	$ 242	$ 11,841

Lowman Uranium Mill Tailings Project
Lowman, Idaho

Total Estimated Cost (TEC): $11,841,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

Description, Objective and Justification

The Uranium Mill Tailings Radiation Control Act of 1978, Public Law 95-604, 42 USC 7901 (hereinafter referred to as the "Act"), authorizes the Department of Energy (DOE) to undertake remedial actions at 24 designated inactive uranium processing sites and associated vicinity properties.

The purpose of the remedial actions is to stabilize and control the uranium mill tailings and other residual radioactive materials in a safe and environmentally sound manner in order to minimize radiation health hazards to the public. Pursuant to the Act, the remedial actions undertaken by DOE are to be accomplished:

- With the full participation of the affected states and Indian tribes.
- In accordance with standards issued by the Environmental Protection Agency (EPA).
- With the concurrence of the Nuclear Regulatory Commission (NRC).

Location:

75 miles northeast of Boise, Idaho; at the junction of Clear Creek and the South Fork Payette River.

Site Description

The total site located on a relatively steep hillside, covers an area of 37 acres. The sand residues are in 10 different piles covering about 10 acres. Total residue is about 67,000 tons. The process used was mechanical instead of chemical and process solutions were not contaminated with dissolved materials. During the period 1955-1960 approximately 200,000 tons of ore were processed at the mill site.

Lowman Uranium Mill Tailings Project
Lowman, Idaho

Total Estimated Cost (TEC): $11,841,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(a) Schedule of Planned Activities

The following table presents the primary tasks for activities at the Lowman site:

Activity	Start	Complete
Environmental Document	01/82	04/88
Conceptual Design	06/87	04/88
Final Design	03/87	03/88
Vicinity Property Remedial Action	04/92	08/92
Processing Site Remedial Action	04/92	09/92
Surveillance and Maintenance	10/92	NA

(b) Management and Contracting

The Uranium Mill Tailings Remedial Action (UMTRA) Project Office has competitively awarded multi-year contracts for a Technical Assistant Contractor (TAC) and a Remedial Action Contractor (RAC) to support the DOE on UMTRA Project activities. The TAC is responsible for: site characterization; NEPA documentation; conceptual design; technology development; technical and management support; and, surevillance and maintenance following completion of remedial actions. The RAC performs: engineering design; remedial action construction management; site health and safety; and, quality assurance. Actual construction will be performed by RAC-managed subcontractors.

(c) Prior Year Achievements

FY 1986

Initiate conceptual design and continue development of environmental assessment.

(d) Current Year Achievements (FY 1987)

Continue work on environmental assessment and initiate processing site engineering.

Lowman Uranium Mill Tailings Project
Lowman, Idaho

Total Estimated Cost (TEC): $11,841,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(e) Reasons for Increases and Decreases

Reasons for increase from the FY 1986 Budget Request Operating Expense funded Data Sheet (TEC = $6,634,000 are as follows:

(1) An increase in the estimated construction costs due to estimate improvements: $77,000
(2) An increase in the cost of data acquisition and NEPA documentation based on experience to date: $985,000
(3) An increase in the cost for surveillance and maintenance: $38,000
(4) An increase in the support costs and contingency based on limited data available: $4,098,000
(5) A decrease in state-share payments due to the TEC increase: $9,000

(f) Cost Estimate

The costs shown include design and construction, research and development, and direct project related support costs to stabilize and control the uranium mill tailings and other residual radioactive material at Lowman, Idaho.

	Total Cost
Design and construction	$ 4,433
Research and development	2,875
Facility operations	78
Direct project related support costs	4,898
Total DOE Cost	12,284
Non-DOE Costs	(443)
Total Estimated Cost	$ 11,841

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(Tabular dollars in thousands. Narrative material in whole dollars.)

Spook Uranium Mill Tailings Project
Spook, Wyoming

Total Estimated Cost (TEC): $10,243,000

Spook Uranium Mill Tailings Project
Spook, Wyoming

Total Estimated Cost (TEC): $10,243,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	Cumulative Prior Years	FY 1985 Estimate			FY 1986 Estimate		FY 1987 Estimate	
	Obs.	B/A	Obs.	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):								
Design and construction	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 93	$ 93
Research and development	943	125	125	125	390	390	889	889
Facility operations	0	0	0	0	0	0	0	0
Direct project related support cost	333	211	211	211	342	342	699	699
Capital equipment	0	0	0	0	0	0	0	0
Total operating expenses	1,276	336	336	336	732	732	1,681	1,681
Other DOE funding:	0	0	0	0	0	0	0	0
Total DOE funding:	1,276	336	336	336	732	732	1,681	1,681
Non-DOE funding:								
State share	0	0	0	0	0	0	(9)	(9)
Total Project funding	$ 1,276	$ 336	$ 336	$ 336	$ 732	$ 732	$ 1,672	$ 1,672

Spook Uranium Mill Tailings Project
Spook, Wyoming

Total Estimated Cost (TEC): $10,243,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1988 Estimate		FY 1989 Estimate		FY 1990 Estimate	
	B/A	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):						
Design and construction	$ 86	$ 86	$ 0	$ 0	$ 98	$ 98
Research and development	114	114	54	54	121	121
Facility operations	0	0	0	0	0	0
Direct project related support costs	325	325	110	110	245	245
Capital equipment	0	0	0	0	0	0
Total operating expenses	525	525	164	164	464	464
Other DOE funding:	0	0	0	0	0	0
Total DOE funding:	525	525	164	164	464	464
Non-DOE funding:						
State share	(9)	(9)	0	0	(10)	(10)
Total Project funding	$ 516	$ 516	$ 164	$ 164	$ 454	$ 454

Spook Uranium Mill Tailings Project
Spook, Wyoming

Total Estimated Cost (TEC): $10,243,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1991 Estimate		FY 1992 Estimate		FY 1993 Estimate		Total Cost
	B/A	B/O	B/A	B/O	B/A	B/O	B/A
Operating expenses (DOE):							
Design and construction	$ 2,455	$ 2,455	$ 357	$ 357	$ 0	$ 0	$ 3,089
Research and development	145	145	156	156	0	0	2,937
Facility operations	0	0	19	19	57	57	76
Direct project related support costs	925	925	878	878	383	383	4,451
Capital equipment	0	0	0	0	0	0	0
Total operating expenses	3,525	3,525	1,410	1,410	440	440	10,553
Other DOE funding:	0	0	0	0	0	0	0
Total DOE funding:	3,525	3,525	1,410	1,410	440	440	10,553
Non-DOE funding:							
State share	(246)	(246)	(36)	(36)	0	0	(310)
Total Project funding:	$ 3,279	$ 3,279	$ 1,374	$ 1,374	$ 440	$ 440	$ 10,243

Spook Uranium Mill Tailings Project
Spook, Wyoming

Total Estimated Cost (TEC): $10,243,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

Description, Objective and Justification

The Uranium Mill Tailings Radiation Control Act of 1978, Public Law 95-604, 42 USC 7901 (hereinafter referred to as the "Act"), authorizes the Department of Energy (DOE) to undertake remedial actions at 24 designated inactive uranium processing sites and associated vicinity properties.

The purpose of the remedial actions is to stabilize and control the uranium mill tailings and other residual radioactive materials in a safe and environmentally sound manner in order to minimize radiation health hazards to the public. Pursuant to the Act, the remedial actions undertaken by DOE are to be accomplished:

- With the full participation of the affected states and Indian tribes.
- In accordance with standards issued by the Environmental Protection Agency (EPA).
- With the concurrence of the Nuclear Regulatory Commisison (NRC).

Location:

48 miles northeast of Casper, Converse County, Wyoming.

Site Description

The site exists among rolling hills and open grasslands in an area dotted with mining activities. The total site covers 60 acres, of which nearly 5 acres are covered with tailings. Portions of the tailings are in the nearby open pit mine. Windblown contamination consists of some 12 acres. From 1962 tc 1965 approximately 187,000 tons of ore were processed at the mill site.

Spook Uranium Mill Tailings Project
Spook, Wyoming

Total Estimated Cost (TEC): $10,243,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(a) Schedule of Planned Activities

The following table presents the primary tasks for activities at the Spook site:

Activity	Start	Complete
Environmental Document	07/81	12/87
Conceptual Design	07/86	11/87
Final Design	04/87	03/88
Vicinity Property Remedial Action	04/91	09/91
Processing Site Remedial Action	04/91	06/92
Surveillance and Maintenance	07/92	NA

(b) Management and Contracting

The Uranium Mill Tailings Remedial Action (UMTRA) Project Office has competitively awarded multi-year contracts for a Technical Assistant Contractor (TAC) and a Remedial Action Contractor (RAC) to support the DOE on UMTRA Project activities. The TAC is responsible for: site charaterization; NEPA documentation; conceptual design; technology development; technical and management support; and, surveillance and maintenance following completion of remedial actions. The RAC performs: engineering design; remedial action construction management; site health and safety; and, quality assurance. Actual construction will be performed by RAC-managed subcontractors.

(c) Prior Year Achievements

FY 1986

Initiate conceptual design and continue development of environmental assessment.

(d) Current Year Achievements (FY 1987)

Continue work on environmental assessment and initiate processing site engineering.

Spook Uranium Mill Tailings Project
Spook, Wyoming

Total Estimated Cost (TEC): $10,243,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(e) Reasons for Increases and Decreases

Reasons for increase from the FY 1986 Budget Request Operating Expense Funded Data Sheet (TEC = $4,961,000) are as follows:

(1) An increase in the construction costs due to estimate improvements and schedule extension: $365,000
(2) An increase in data acquisition and NEPA costs based on experience to date: $1,132,000
(3) An increase in the cost of surveillance and maintenance: $36,000
(4) An increase in the support costs and contingency: $3,776,000
(5) An increase in state-share payments due to the TEC increase: ($27,000)

(f) Cost Estimate

The costs shown include design and construction, research and development, and direct project related support costs to stabilize and control the uranium mill tailings and othe residual radioactive material at Spook, Wyoming.

	Total Cost
Design and construction	$ 3,089
Research and development	2,937
Facility operations	76
Direct project related support costs	4,451
Total DOE Cost	10,553
Non-DOE Costs	(310)
Total Estimated Cost	$ 10,243

DEPARTMENT OF ENERGY
FY 1987 CONGRESSIONAL BUDGET REQUEST
OPERATING EXPENSE FUNDED PROJECT DATA SHEET
NUCLEAR ENERGY

Energy Supply Research and Development
Remedial Action and Waste Technology

(Tabular dollars in thousands. Narrative material in whole dollars.)

Monument Valley Uranium Mill Tailings Project
Monument Valley, Arizona

Total Estimated Cost (TEC): $16,136,000

Monument Valley Uranium Mill Tailings Project
Monument Valley, Arizona

Total Estimated Cost (TEC): $16,136,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	Cumulative Prior Years	FY 1985 Estimate			FY 1986 Estimate		FY 1987 Estimate	
	Obs.	B/A	Obs.	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):								
Design and construction	$ 0	$ 0	$ 0	$ 0	$ 764	$ 764	$ 0	$ 0
Research and development	979	713	713	713	65	65	57	57
Facility operations	0	0	0	0	0	0	0	0
Direct project related support cost	351	348	348	348	60	60	105	105
Capital equipment	0	0	0	0	0	0	0	0
Total operating expenses	1,330	1,061	1,061	1,061	889	889	162	162
Other DOE funding:	0	0	0	0	0	0	0	0
Total DOE funding:	1,330	1,061	1,061	1,061	889	889	162	162
Non-DOE funding:								
State share	0	0	0	0	0	0	0	0
Total Project funding	$ 1,330	$ 1,061	$ 1,061	$ 1,061	$ 889	$ 889	$ 162	$ 162

Monument Valley Uranium Mill Tailings Project
Monument Valley, Arizona

Total Estimated Cost (TEC): $16,136,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1988 Estimate		FY 1989 Estimate		FY 1990 Estimate	
	B/A	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):						
Design and construction	$ 87	$ 87	$ 0	$ 0	$ 2,358	$ 2,358
Research and development	79	79	56	56	0	0
Facility operations	0	0	0	0	0	0
Direct project related support costs	81	81	110	110	3,255	3,255
Capital equipment	0	0	0	0	0	0
Total operating expenses	247	247	166	166	5,613	5,613
Other DOE funding:	0	0	0	0	0	0
Total DOE funding:	247	247	166	166	5,613	5,613
Non-DOE funding:						
State share	0	0	0	0	0	0
Total Project funding	$ 247	$ 247	$ 166	$ 166	$ 5,613	$ 5,613

Monument Valley Uranium Mill Tailings Project
Monument Valley, Arizona

Total Estimated Cost (TEC): $16,136,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1991 Estimate		FY 1992 Estimate		FY 1993 Estimate		Total Cost
	B/A	B/O	B/A	B/O	B/A	B/O	B/A
Operating expenses (DOE):							
Design and construction	$ 6,308	$ 6,308	$ 0	$ 0	$ 0	$ 0	$ 9,517
Research and development	0	0	0	0	0	0	1,949
Facility operations	0	0	0	0	0	0	0
Direct project related support costs	115	115	119	119	126	126	4,670
Capital equipment	0	0	0	0	0	0	0
Total operating expenses	6,423	6,423	119	119	126	126	16,136
Other DOE funding:	0	0	0	0	0	0	0
Total DOE funding:	6,423	6,423	119	119	126	126	16,136
Non-DOE funding:							
State share	0	0	0	0	0	0	0
Total Project funding:	$ 6,423	$ 6,423	$ 119	$ 119	$ 126	$ 126	$ 16,136

Monument Valley Uranium Mill Tailings Project
Monument Valley, Arizona

Total Estimated Cost (TEC): $16,136,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

Description, Objective and Justification

The Uranium Mill Tailings Radiation Control Act of 1978, Public Law 95-604, 42 USC 7901 (hereinafter referred to as the "Act"), authorizes the Department of Energy (DOE) to undertake remedial actions at 24 designated inactive uranium processing sites and associated vicinity properties.

The purpose of the remedial actions is to stabilize and control the uranium mill tailings and other residual radioactive materials in a safe and environmentally sound manner in order to minimize radiation health hazards to the public. Pursuant to the Act, the remedial actions undertaken by DOE are to be accomplished:

- With the full participation of the affected states and Indian tribes.
- In accordance with standards issued by the Environmental Protection Agency (EPA).
- With the concurrence of the Nuclear Regulatory Commission (NRC).

Location:

Northeast corner of Arizona, on Navajo Nation land, just east of Monument Valley, Arizona; 20 miles east of U.S. 163 where it passes through Monument Valley.

Site Description

The site is located on relatively level terrain. The site consists of 90 acres. The tailings, located in two piles, cover about 30 acres; the mill site covers about 5 acres. From 1955 to 1968 approximately 1.1 million tons of ore were processed at the mill site.

The site is very remote and the existence and condition of a water supply is unknown. Most of the original equipment and structures have been demolished and removed.

Monument Valley Uranium Mill Tailings Project
Monument Valley, Arizona

Total Estimated Cost (TEC): $16,136,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(a) Schedule of Planned Activities

The following table presents the primary tasks for activities at the Monument Valley site:

Activity	Start	Complete
Environmental Document	07/81	09/86
Conceptual Design	12/85	12/86
Final Design	10/85	10/86
Vicinity Property Remedial Action	NA	NA
Processing Site Remedial Action	10/89	09/91
Surveillance and Maintenance	10/91	NA

(b) Management and Contracting

The Uranium Mill Tailings Remedial Action (UMTRA) Project Office has competitively awarded multi-year contracts for a Technical Assistance Contractor (TAC) and a Remedial Action Contractor (RAC) to support the DOE on UMTRA Project activities. The TAC is responsible for: site characterization; NEPA documentation; conceptual design; technology development; technical and management support; and, surveillance and maintenance following completion of remedial actions. The RAC performs: engineering design; remedial action construction management; site health and safety; and, quality assurance. Actual construction will be performed by RAC-managed subcontractors.

(c) Prior Year Achievements

FY 1985

Initiated environmental assessment and site conceptual design.

FY 1986

Complete environmental assessment and initiate processing site engineering.

Monument Valley Uranium Mill Tailings Project
Monument Valley, Arizona

Total Estimated Cost (TEC): $16,136,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(d) Current Year Achievements (FY 1987)

Complete processing site engineering.

(e) Reasons for Increases and Decreases

Reasons for increase from the FY 1986 Budget Request Operating Expense Funded Data Sheet (TEC = $10,993,000) are as follows:

(1) An increase in construction costs due to estimate refinement and schedule extension: $1,450,000
(2) A decrease in data acquisition and NEPA costs: ($5,000)
(3) A decrease in the cost for surveillance and maintenance: ($102,000)
(4) An increase in the estimated management support costs: $3,800,000

(f) Cost Estimate

The costs shown include design and construction, research and development, and direct project related support costs to stabilize and control the uranium mill tailings and other residual radioactive material at Monument Valley, Arizona.

	Total Cost
Design and construction	$ 9,517
Research and development	1,949
Facility operations	0
Direct project related support costs	4,670
Total DOE Cost	16,136
Non-DOE Costs	0
Total Estimated Cost	$ 16,136

DEPARTMENT OF ENERGY
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Energy Supply Research and Development
Remedial Action and Waste Technology

(Tabular dollars in thousands. Narrative material in whole dollars.)

Edgemont Vicinity Properties Project
Edgemont, South Dakota

Total Estimated Cost (TEC): $4,515,000

Edgemont Vicinity Properties Project
Edgemont, South Dakota

Total Estimated Cost (TEC): $4,515,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	Cumulative Prior Years	FY 1985 Estimate			FY 1986 Estimate		FY 1987 Estimate	
	Obs.	B/A	Obs.	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):								
Design and construction	$ 1,053	$ 360	$ 360	$ 360	$ 2,244	$ 2,244	$ 0	$ 0
Research and development	210	209	209	209	0	0	0	0
Facility operations	0	0	0	0	0	0	0	0
Direct project related support cost	494	210	210	210	100	100	0	0
Capital equipment	0	0	0	0	0	0	0	0
Total operating expenses	1,757	779	779	779	2,344	2,344	0	0
Other DOE funding:	0	0	0	0	0	0	0	0
Total DOE funding:	1,757	779	779	779	2,344	2,344	0	0
Non-DOE funding:								
State share	(105)	(36)	(36)	(36)	(224)	(224)	0	0
Total Project funding	$ 1,652	$ 743	$ 743	$ 743	$ 2,120	$ 2,120	$ 0	$ 0

Edgemont Vicinity Properties Project
Edgemont, South Dakota

Total Estimated Cost (TEC): $4,515,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1988 Estimate		FY 1989 Estimate		FY 1990 Estimate	
	B/A	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):						
Design and construction	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
Research and development	0	0	0	0	0	0
Facility operations	0	0	0	0	0	0
Direct project related support costs	0	0	0	0	0	0
Capital equipment	0	0	0	0	0	0
Total operating expenses	0	0	0	0	0	0
Other DOE funding:	0	0	0	0	0	0
Total DOE funding:	0	0	0	0	0	0
Non-DOE funding:						
State share	0	0	0	0	0	0
Total Project funding	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0

Edgemont Vicinity Properties Project
Edgemont, South Dakota

Total Estimated Cost (TEC): $4,515,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1991 Estimate		FY 1992 Estimate		FY 1993 Estimate		Total Cost
	B/A	B/O	B/A	B/O	B/A	B/O	B/A
Operating expenses (DOE):							
Design and construction	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 3,657
Research and development	0	0	0	0	0	0	419
Facility operations	0	0	0	0	0	0	0
Direct project related support costs	0	0	0	0	0	0	804
Capital equipment	0	0	0	0	0	0	0
Total operating expenses	0	0	0	0	0	0	4,880
Other DOE funding:	0	0	0	0	0	0	0
Total DOE funding:	0	0	0	0	0	0	4,880
Non-DOE funding:							
State share	0	0	0	0	0	0	(365)
Total Project funding:	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 4,515

Edgemont Vicinity Properties Project
Edgemont, South Dakota

Total Estimated Cost (TEC): $4,515,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

Description, Objective and Justification

The Uranium Mill Tailings Radiation Control Act of 1978, Public Law 95-604, 42 USC 7901 (hereinafter referred to as the "Act"), authorizes the Department of Energy (DOE) to undertake remedial actions at 24 designated inactive uranium processing sites and associated vicinity properties.

The purpose of the remedial actions is to stabilize and control the uranium mill tailings and other residual radioactive materials in a safe and environmentally sound manner in order to minimize radiation health hazards to be public. Pursuant to the Act, the remedial actions undertaken by DOE are to be accomplished:

- With the full participation of the affected states and Indian tribes.
- In accordance with standards issued by the Environmental Protection Agency (EPA).
- With the concurrence of the Nuclear Regulatory Commission (NRC).

Location:

Southwest corner of South Dakota, in Fall River County, at the junction of U.S. Highway 18 and S.D. State Highway 52.

Site Description

It is estimated that some 12,000 cubic yards of tailings and contaminated materials will be removed from approximately 110 vicinity properties located in and near Edgemont, South Dakota.

The tailings and other materials will be temporarily stored at the inactive mill site on the eastern edge of town. The mill site is owned by the Tennessee Valley Authority (TVA) and is to be decommissioned by TVA. The materials from the vicinity properties will be moved to a permanent storage site 3 miles to the southeast of the mill site during decommissioning of the mill site.

Edgemont Vicinity Properties Project
Edgemont, South Dakota

Total Estimated Cost (TEC): $4,515,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(a) Schedule of Planned Activities

The following table presents the primary tasks for activities at the Edgemont site:

Activity	Start	Complete
Vicinity Property Remedial Action	08/83	09/86

(b) Management and Contracting

The Uranium Mill Tailings Remedial Action (UMTRA) Project Office has competitively awarded multi-year contracts for a Technical Assistance Contractor (TAC) and a Remedial Action Contractor (RAC) to support the DOE on UMTRA Project activities. The TAC is responsible for: site characterization; NEPA documentation; conceptual design; technology development; technical and management support; and, surveillance and maintenance following completion of remedial actions. The RAC performs: engineering design; remedial action construction management; site health and safety; and, quality assurance. Actual construction will be performed by RAC-managed subcontractors.

(c) Prior Year Achievements

FY 1985

Initiated vicinity property engineering and complete remedial actions for a total of 40 vicinity properties.

FY 1986

Complete remedial action for all remaining vicinity properties

(d) Current Year Achievements (FY 1987)

No remedial action is planned for FY 1987.

Edgemont Vicinity Properties Project
Edgemont, South Dakota

Total Estimated Cost (TEC): $4,515,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(e) Reasons for Increases and Decreases

Reasons for decrease from the FY 1986 Budget Request Operating Expense Funded Data Sheet (TEC = $5,221,000) are as follows:

(1) A decrease in the estimated costs due to estimate revisions: ($757,000)
(2) A decrease in the estimated costs for audit and certification activity: ($200,000)
(3) An increase in the estimated management support costs: $158,000
(4) Decreased state-share payments in relation to the TEC decrease: $93,000

(f) Cost Estimate

The costs shown include design and construction, research and development, and direct project related support costs to stabilize and control the uranium mill tailings and other residual radioactive material for the vicinity properties at Edgemont, South Dakota.

	Total Cost
Design and construction	$ 3,657
Research and development	419
Facility operations	0
Direct project related support costs	804
Total DOE Cost	4,880
Non-DOE Costs	(365)
Total Estimated Cost	$ 4,515

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Energy Supply Research and Development
Remedial Action and Waste Technology

(Tabular dollars in thousands. Narrative material in whole dollars.)

Weldon Spring Site Remedial Action Project (WSSRAP)
Oak Ridge Operations Office

Total Project Cost Estimate (TPCE): $357,667,000
(For Engineering, Maintenance and Surveillance,
Construction, and Decommissioning Operations)
based on pre-conceptual engineering design data.

Weldon Spring Site Remedial Action Project (WSSRAP)
Oak Ridge Operations Office

Total Project Cost Estimate (TPCE): $357,667,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	Cumulative Prior Years	FY 1985 Actual			FY 1986 Estimate	
	Obs.	B/A	Obs.	B/O	B/A	B/O
Operating expenses (DOE):						
Engineering and decommissioning	$ 2,096	$ 1,671	$ 1,671	$ 1,702	$ 4,650	$ 4,650
Direct project related support costs	218	269	269	269	240	240
Capital equipment	25	0	0	0	10	10
Total operating expenses	2,339	1,940	1,940	1,971	4,900	4,900
Other DOE funding:						
Maintenance and surveillance	0	0	0	0	145	145
Total DOE funding:	2,339	1,940	1,940	1,971	5,045	5,045
Non-DOE funding:	0	0	0	0	0	0
Total Project funding	$ 2,339	$ 1,940	$ 1,940	$ 1,971	$ 5,045	$ 5,045

Weldon Spring Site Remedial Action Project (WSSRAP)
Oak Ridge Operations Office

Total Project Cost Estimate (TPCE): $357,667,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1987 Estimate		FY 1988 Estimate		FY 1989 Estimate		FY 1990 Estimate	
	B/A	B/O	B/A	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):								
Engineering and decommissioning	$ 12,959	$ 10,109	$ 26,316	$ 20,416	$ 28,391	$ 29,391	$ 32,365	$ 33,365
Direct project related support costs	537	537	221	221	235	235	251	251
Capital equipment	200	200	200	200	200	200	200	200
Total operating expense	13,696	10,846	26,737	20,837	28,826	29,826	32,816	33,816
Other DOE funding:								
Maintenance and surveillance	154	154	163	163	174	174	184	184
Total DOE funding:	13,850	11,000	26,900	21,000	29,000	30,000	33,000	34,000
Non-DOE funding:	6,000	6,000	7,900	7,900	12,000	11,000	20,000	16,000
Total Project funding	$ 19,850	$ 17,000	$ 34,800	$ 28,900	$ 41,000	$ 41,000	$ 53,000	$ 50,000

Weldon Spring Site Remedial Action Project (WSSRAP)
Oak Ridge Operations Office

Total Project Cost Estimate (TPCE): $357,667,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1991 Estimate		Estimate Through Project Completion		Total Cost
	B/A	B/O	B/A	B/O	B/A
Operating expenses (DOE):					
Engineering and decommissioning	$ 29,338	$ 30,338	$ 84,573	$ 90,292	$222,359
Direct project related support costs	266	266	1,439	1,439	3,676
Capital equipment	200	200	600	600	1,635
Total operating expense	29,804	30,804	86,612	92,331	227,670
Other DOE funding:					
Maintenance and surveillance	196	196	1,191	1,191	2,207
Total DOE funding:	30,000	31,000	87,803	93,522	229,877
Non-DOE funding:	19,000	19,000	62,890	67,890	127,790
Total Project funding:	$ 49,000	$ 50,000	$150,693	$161,412	$357,667

Weldon Spring Site Remedial Action Project (WSSRAP)
Oak Ridge Operations Office

Total Project Cost Estimate (TPCE): $357,667,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

Description, Objective and Justification

The Weldon Spring Site is located in St. Charles County, Missouri, about 30 miles west of St. Louis, on land formerly used by the Department of the Army (DA) as a trinitrotoluene (TNT) ordnance works. The site consists of a 3.4 ha (9-acre) abandoned limestone quarry; a 21 ha (51-acre) raffinate disposal area; and a 69.6 ha (169-acre) mothballed uranium feed materials plant. The feed plant was built during 1955-1957 by the Atomic Energy Commission (AEC), predecessor agency to DOE, and operated by Mallinckrodt Inc. for the AEC from 1957 to 1966. During operations of the plant, the buildings, equipment, immediate terrain, process sewer system and drainage easement to the Missouri River became contaminated with uranium, thorium, and their decay products.

During the period 1943-1957, DA utilized the Weldon Spring Quarry (WSQ) for disposal of rubble and soils contaminated with TNT and dinitrotoluene (DNT), and DOE disposed of building rubble and soils contaminated with thorium, uranium and decay products. The WSQ contains a total of 99,400 m^3 (130,000 yd^3) of wastes, including quarry materials contaminated by the radioactive wastes.

In 1967, the feed materials plant site was selected for a herbicide production facility and except for the materials stored in the Weldon Spring Raffinate Pits (WSRP), the site was transferred back to the DA and renamed the Weldon Spring Chemical Plant (WSCP). The Army began a major effort to decontaminate three process buildings for herbicide production. The cleanup was not totally successful, and subsequently, reduced requirements for the herbicide and increased cleanup costs resulted in cancellation in 1969. Approximately 238,600 m^3 (312,000 yd^3) of contaminated soil, equipment, and building rubble remaining on the WSCP site requires cleanup to meet current guidelines for unrestricted use.

The 51 acres encompassing the WSRP site were transferred back to the AEC (now DOE) in 1971. The WSRP contain approximately 168,200 m^3 (220,000 yd^3) of residues. In addition, it is estimated that 98,900 m^3 (129,400 yd^3) of clay beneath the pits was contaminated by these radioactive wastes.

The sites have been in care and custody status since activities ceased in 1969. In June 1975 environmental and radiological surveys were initiated. Preliminary analyses show that the site cannot be released for unrestricted use without radiological decontamination. Trace levels of TNT and DNT residues are present throughout the area; however, no explosive hazard exists. Preliminary estimate indicates approximately 78,000 m^3 (102,000 yd^3) of contaminated material may require removal and disposal. Monitoring shows continuing offsite migration of radionuclides. Remedial actions are necessary to stabilize the wastes.

Weldon Spring Site Remedial Action Project (WSSRAP)
Oak Ridge Operations Office

Total Project Cost Estimate (TPCE): $357,667,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

On November 27, 1984, the OMB directed DOE to assume custody and accountability for the WSCP from the DA. The DOE was directed to assume responsibility for the decontamination of the WSCP and to integrate that work with other DOE remedial actions proposed for the WSQ, WSRP, and Weldon Spring vicinity properties (WSVP). The DOE and DA were directed to share the cost for the WSCP remedial actions. A Memorandum of Understanding regarding the site transfer and the allocation of funding sharing was approved on February 11, 1985. Transfer of custody and control of the WSCP was effected on October 1, 1985.

The scope of the WSSRAP includes:

- Maintenance and surveillance of the site as necessary to maintain public safety and reduce radiological impact to as low as reasonably achievable, in preparation for site disposition.
- Integrated planning, engineering, and technology development as necessary to support evaluation of long-range disposition alternatives.
- Complete the environmental impact assessment process.
- Plan and implement the remedial action program required to adequately cleanup the site.
- Assume custody and accountability for the WSCP at the beginning of FY 1986 and integrate remedial actions at the WSCP with the WSRP, WSQ, and WSVP.
- Priority will be given to decontaminating the WSQ to reduce migration of radiologic contaminants toward the well field serving portions of St. Charles County.

Weldon Spring Site Remedial Action Project (WSSRAP)
Oak Ridge Operations Office

Total Project Cost Estimate (TPCE): $357,667,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(a) Schedule of Planned Activities

The following table presents the total program broken down by primary tasks:

Activity	Start	Complete
Radiological, Geological, Chemical and Hydrological Characterization	1st Qtr., FY 1982	4th Qtr., FY 1987
Engineering Studies	1st Qtr., FY 1982	4th Qtr., FY 1987
NEPA Support (Pits, Quarry, and Vicinity Property)	1st Qtr., FY 1982	1st Qtr., FY 1987
NEPA Support (Chemical Plant)	4th Qtr., FY 1986	2nd Qtr., FY 1988
Design Engineering and Support Remedial Actions	1st Qtr., FY 1987	4th Qtr., FY 1996
Remedial Action		
Site Preparation/Support Facilities	1st Qtr., FY 1987	2nd Qtr., FY 1988
Quarry	1st Qtr., FY 1988	4th Qtr., FY 1991
Raffinate Pits	1st Qtr., FY 1988	4th Qtr., FY 1994
Vicinity Properties	3rd Qtr., FY 1992	4th Qtr., FY 1994
Chemical Plant	3rd Qtr., FY 1989	4th Qtr., FY 1995

(b) Management and Contracting

Through FY 1985, the project was managed for the DOE by the Oak Ridge Operations Office (OR) reporting through the Richland Operations Office. The OR Technical Services Division (TSD) provided technical, administrative, and financial management of the Weldon Spring project on a day-to-day basis in compliance with Surplus Facilities Management Program policies and all other applicable DOE orders, directives, and specific guidance. In this capacity, OR-TSD oversaw the work of Bechtel National, Inc. (BNI) which acted as the OR-TSD representative in the planning and management of the WSS project, during the conceptual study period, since October 1981. This OR-TSD operational role concluded in effect on October 1, 1985, with the establishment of the Project Manager. However, the Project Manager will report to the OR-AMC&E through the Director, OR-TSD in FY 1986 until requisite organization and staffing actions occur commensurate with evolving needs. An onsite Project Office will be established by October 1986.

Weldon Spring Site Remedial Action Project (WSSRAP)
Oak Ridge Operations Office

Total Project Cost Estimate (TPCE): $357,667,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

The Project Manager will be responsible for WSSRAP as a DOE Major Project under DOE Order 5700. The Project Office will provide technical, administrative, and financial management of the integrated project on a day-to-day basis. Competitive procurement was planned during FY 1985 and FY 1986, with a Project Management Contractor (PMC) to be selected prior to October 1, 1986. The PMC will be responsible for the final design and construction, surveillance and maintenance, and insuring completion of the project in accordance with DOE guidance. In implementing approved remedial actions, the PMC will utilize local subcontractors in the Weldon Spring region to the extent that it is cost-effective and programmatically expedient.

Argonne National Laboratory (ANL) is the EIS preparation contractor.

The Oak Ridge Associated Universities (ORAU) is the radiological survey contractor for the vicinity properties.

(c) Prior Year Achievements

Site surveillance and maintenance were performed for the WSRP and WSQ; surface water samples were analyzed; conceptual studies were performed; geological conditions were investigated; and an Engineering Evaluation of Alternatives was prepared. The Project Management Plan was prepared and updated. Water balance studies and environmental monitoring were performed. A plan for integrating the WSCP work with the WSRP and WSQ work was developed. A procurement plan was prepared for acquisition of the PMC for final design and implementation of the remedial work. A Request for Proposal was prepared and issued during FY 1985. The project was designated a Major Project.

(d) Current Year Planning Achievements

In FY 1986 the WSSRAP Project Office will be established on-site and will assume responsibility for the project from OR-TSD. Site surveillance and maintenance and environmental monitoring continued. The radiological report on the WSQ and the 1985 Environmental Report were issued. The EIS will be prepared. A PMC will be selected and a contract signed. Radiological characterization of the WSCP began.

Weldon Spring Site Remedial Action Project (WSSRAP)
Oak Ridge Operations Office

Total Project Cost Estimate (TPCE): $357,667,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(e) Budget Year Planned Achievements

The new PMC will assume responsibility in FY 1987. The current contractor will provide assistance during a transition period. Detailed engineering and remedial action for the WSQ will be undertaken, as will disposal cell site preparation at the WSRP. Water treatment of WSRP water will begin. Surveillance and maintenance and environmental monitoring will continue. Necessary permits for receiving WSQ wastes at the WSRP and/or WSCP for temporary storage will be initiated, as will permits for water discharge. Geological/hydrological, chemical, and radiological characterization of the WSCP will be completed. Preliminary engineering for WSCP remedial actions will be initiated.

(f) Reasons for Increase and Decreases

The overall project scope has been expanded to include the WSCP and redesignated as a Major Project entitled, "The Weldon Spring Site Remedial Action Project."

(g) Cost Estimate (WSRP, WSQ, WSVP and WSCP)

	Item Cost	Total Cost
1. Operating Expenses		$288,394
a. Radiological characterization, conceptual engineering in support of NEPA activities, preparation of Project Management Plan, Geologic Report, monitoring reports, and related activities during FY 1982-1985	$ 3,127	
b. NEPA	1,270	
c. Engineering and support for remedial action	22,850	
d. Decontamination and Decommissioning Operations		
Decommissioning WSRP, WSQ, and WSVP	58,503	
Site preparation and removal of clean facilities, WSCP	29,775	
Removal of slightly contaminated facilities, WSCP	9,350	
Removal of highly contaminated facilities, WSCP	49,135	
Removal of sewers and support facilities, WSCP	18,690	
Land decontamination, WSCP	21,360	
Compact waste delivered to pit area, WSCP	16,640	
Radiological support, WSCP	13,485	

Total Project Cost Estimate (TPCE): $357,667,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

e.	Management Support	32,993	
f.	Surveillance and Maintenance	7,066a/	
	Guard Services and Groundskeeping	4,150	
g.	Contingency @ approximately 24%		69,273
	Total Estimated Cost		$357,667a/

Footnote to Cost Estimate:

a/ The Memorandum of Understanding between DA and DOE approved February 11, 1985, limited the DA funding responsibility (subject to availability of appropriated funds) to 50 percent of the cost incurred to address contamination at WSCP. This includes interim control actions, remedial action planning and engineering, site characterization, NEPA documentation, plant demolition, site cleanup, and waste disposal. The DOE share includes 50 percent of the above items plus 100 percent of the cost of guards, groundskeeping, long-term management and monitoring, actions at WSCP unrelated to decontaminating WSCP, and funding of other Weldon Spring sites. Where indirect and general purpose expenses are incurred on the WSQ, WSRP, and/or WSCP, the share attributable to WSCP will be fairly apportioned. The preliminary estimate of the DA share is $127,790,000, and the DOE share for WSCP remedial actions is $129,997,000.

Assumptions:

1. The Schedule 47 is based on the DOE management determination that WSSRAP will consolidate the work at the WSQ, WSRP, WSVP, and WSCP and will be managed by the DOE-Oak Ridge as a Major Project under DOE Order 5700.

   Beginning October 1, 1985, and continuing to not later than September 30, 1986, the Project Manager reports to the OR Assistant Manager for Construction and Engineering through the Director, OR-TSD. In this way, project support contracting activities, site management, program organization, and work transitions occur consistent with evolving needs. The change to formal reporting by the Project Manager to the AMC&E will take place during FY 1986 as circumstances and project activities dictate.

2. The TPCE of this project is an integration of cost estimates from two subprojects, consisting of (a) the WSRP, WSQ, and WSVP, and (b) the WSCP. The integrated TPCE is the sum of these two subprojects, with no credit taken at this time for efficiencies achievable from consolidated management and coordination of effort. Refinements in the TPCE will be made during FY 1987 and FY 1988 as design engineering is completed and a decision is made on where to dispose of the waste.

Weldon Spring Site Remedial Action Project (WSSRAP)
Oak Ridge Operations Office

Total Project Cost Estimate (TPCE): $357,667,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

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a. The TPCE for the WSRP, WSQ, and WSVP, subproject is based on an Engineering Evaluation of Alternatives (EEA) study which has been performed and includes:

- Stabilization and containment of the waste currently stored at the WSRP.
- Excavation and transportation of the waste currently stored at the WSQ to the WSRP for containment.
- Excavation and transportation of the waste from the WSVP to the WSRP for containment.

b. The TPCE for the WSCP sub-project is based upon a DA Program Plan for the Decontamination of Weldon Spring Chemical Plant (Report ESG-79-31, Rockwell, 1979) with DOE preliminary revisions resulting in the following:

- The costs in the 1979 study have been escalated to year-of-expenditure dollars.
- No estimate for contingency was included in the 1979 study. Contingency of approximately 24 percent has been added for consistency with DOE program guidelines.
- Stabilization and entombment of the contaminated waste generated by the WSCP decontamination and demolition will be at a Weldon Spring Site disposal facility.
- Clean (uncontaminated) waste and scrap will be disposed of in a local landfill licensed by the State of Missouri.
- To the extent feasible, uncontaminated and/or decontaminated material and equipment will be sold for salvage or excessed rather than disposed of in waste storage facilities.
- The remedial actions taken on the WSCP will release as much of the site as possible for unrestricted use.

3. The general qualifications and assumptions used in the preparation of the integrated cost estimate include:

   - The cost estimate is based on volumes of waste determined from available data and is subject to change pending receipt of more current and complete information. For the WSCP, the estimated cost is preliminary and is based on very limited outdated data.
   - The annual funding shown in this data sheet will be provided so that remedial action activities can proceed on an orderly and realistic schedule to minimize overall project cost due to additional escalation.
   - TPCE of the project does not include surveillance and maintenance activities which may be required beyond completion of remedial actions.
   - Estimate does not include WSQ or WSRP costs prior to FY 1982, nor WSCP costs prior to FY 1986.
   - The TPCE and detailed tabular data are expressed in year-of-expenditure dollars.
   - Contingency is included at approximately 24 percent.

4. TPCE in year-of-expenditure dollars ranges from $357,667,000 to $850,000,000 dependent upon the option chosen by DOE as a result of the NEPA process. The lowest cost estimate used in this submittal is based upon the selection of the alternative to dispose of waste in a disposal cell to be developed at the WSS.

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(Tabular dollars in thousands. Narrative material in whole dollars.)

Mound ANSPD Areas Decommissioning Project
Albuquerque Operations Office
Dayton Area Office

Total Project Cost Estimate (TPCE): $36,547,000
(For Engineering and Decommissioning Operations)

Mound ANSPD Areas Decommissioning Project
Albuquerque Operations Office
Dayton Area Office

Total Project Cost Estimate (TPCE): $36,547,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	Cumulative Prior Years	FY 1985 Actual			FY 1986 Estimate	
	Obs.	B/A	Obs.	B/O	B/A	B/O
Operating expenses (DOE):						
Decommissioning operations	$ 20,260	$ 4,200	$ 4,200	$ 4,190	$ 4,340	$ 4,350
R&D related to construction	0	0	0	0	0	0
Facility operations	0	0	0	0	0	0
Direct project related support costs	0	0	0	0	0	0
Capital equipment	0	0	0	0	0	0
Total operating expenses	20,260	4,200	4,200	4,190	4,340	4,350
Other DOE funding:	0	0	0	0	0	0
Total DOE funding:	20,260	4,200	4,200	4,190	4,340	4,350
Non-DOE funding:	0	0	0	0	0	0
Total Project funding	$ 20,260	$ 4,200	$ 4,200	$ 4,190	$ 4,340	$ 4,350

Mound ANSPD Areas Decommissioning Project
Albuquerque Operations Office
Dayton Area Office

Total Project Cost Estimate (TPCE): $36,547,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1987 Estimate		FY 1988 Estimate		Total Cost
	B/A	B/O	B/A	B/O	B/A
Operating expenses (DOE):					
Decommissioning operations	$ 4,360	$ 4,360	$ 3,387	$ 3,387	$ 36,547
R&D related to construction	0	0	0	0	0
Facility operations	0	0	0	0	0
Direct project related support costs	0	0	0	0	0
Capital equipment	0	0	0	0	0
Total operating expenses	4,360	4,360	3,387	3,387	36,547
Other DOE funding:	0	0	0	0	0
Total DOE funding:	4,360	4,360	3,387	3,387	36,547
Non-DOE funding:	0	0	0	0	0
Total Project funding	$ 4,360	$ 4,360	$ 3,387	$ 3,387	$ 36,547

Mound ANSPD Areas Decommissioning Project
Albuquerque Operations Office
Dayton Area Office

Total Project Cost Estimate (TPCE): $36,547,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

Description, Objective and Justification

The Mound Advanced Nuclear systems and Projects Division (ANSPD) Areas are located at the Mound Site in Miamisburg, Ohio. Mound is owned by the Department of Energy (DOE) and operated by Monsanto Research Corporation. The 303 acre site is located in the suburban Dayton, Ohio, area. Land to north, east, and west of the site is used for residential housing and the area to the south for agricultural purposes.

Because of DOE's concern for the presence of large quantities of unencapsulated plutonium-238 in facilities that do not meet current plutonium facilities design criteria and which are near a large metropolitan area, a directive was issued to remove operations from Mound which involved large quantities of unencapsulated plutonium-238.

The ANSPD plutonium operations were located at Mound in portions of the Plutonium Processing (PP) Building, the Research (R) Building, and the Waste Transfer System (WTS). The plutonium-238 was processed for use as heat sources in the NASA space program. Operations ceased in FY 1977 and decommissioning operations were initiated in FY 1978 and are expected to be completed by FY 1988.

The Office of Military Applications (OMA) also processed plutonium-238 in the PP and R Buildings utilizing common processing facilities with ANSPD. Since the processing operations ceased, decommissioning operations were coordinated and funded jointly by ANSPD and OMA in areas of joint ownership to minimize duplication of efforts; effectively utilize resources; minimize environmental, safety, and health risks; follow a logical decommissioning sequence; and prevent shifting of last user cost responsibilities as agreed to in the NE/OMA Memorandum of Understanding. Funding responsibility for decommissioning the inactive ANSPD areas was assumed by the Office of Nuclear Energy - Waste Management in FY 1981.

The decommissioning effort in the PP and R Buildings is two-phased: 1) clean and remove equipment and services from affected gloveboxes, seal contamination, disconnect, and package the empty gloveboxes in approved waste containers for shipment and burial; and 2) perform extensive structural decontamination of the affected areas to remove or seal residual contamination.

The decommissioning effort on the WTS involves removal of approximately 5,000 linear feet of below-grade contaminated piping, dismantlement of an associated storage and pumping facility (Building 41) and the removal of contaminated soil.

Mound ANSPD Areas Decommissioning Project
Albuquerque Operations Office
Dayton Area Office

Total Project Cost Estimate (TPCE): $36,547,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

The intent of DOE's quality assurance program (DOE Order 5700.6A) is met with independent verification.

The four year projection (FY 1985-1988) contained in this document is balanced to minimize resource increases or decreases. This projection is coordinated with a level funding effort from OMA, so that, the combined projects will satisfy the intent of DOE by maximizing the effort and maintaining a safe and efficient decommissioning program.

Continued project plan funding eliminates an estimated $2,000,000 per year surveillance and maintenance cost and radiological risks to personnel and the environment associated with inactive contaminated areas. The decommissioned areas of PP and R Buildings will provide approximately 23,000 square feet of open areas for new or expanded laboratory/processing operations versus construction of new laboratories and buildings.

Some of the previously decommissioned laboratories are currently being reused by other DOE programs. Current uncommitted laboratory space at Mound is minimal.

(a) Schedule of Planned Activities

The following table presents the program broken down by primary tasks.

Activity	Start	Complete
PP Building Decommissioning	1st Qtr., FY 1978	4th Qtr., FY 1988
R Building Decommissioning	1st Qtr., FY 1976	4th Qtr., FY 1988
WTS Decommissioning	1st Qtr., FY 1982	4th Qtr., FY 1988

Mound ANSPD Areas Decommissioning Project
Albuquerque Operations Office
Dayton Area Office

Total Project Cost Estimate (TPCE): $36,547,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(b) Management and Contracting

Project management, technical, cost, and schedule management for the project is provided by DOE-Albuquerque Operations Office. Monsanto Research Corporation is the resident contractor at Mound performing the decommissioning operations.

(c) Prior Year Achievements

In the PP Building, equipment, piping, and services continued to be removed; structural decontamination was completed in 15 laboratories, and removal of the contaminated filtration system (filter banks) was initiated. In R Building, glovebox removal was completed in one laboratory and structural decontamination of two laboratories was completed. In the WTS, an additional 1,070 linear feet of underground lines were removed and Building 41 decommissioning efforts were continued with the removal of the above ground structure.

(d) Current Year Achievements

During FY 1986, the following activities are scheduled in the PP Building: equipment, piping, and services continue to be removed and structural decontamination will be completed in eight laboratories and several support rooms. In the R Building, structural decontamination will be initiated in the remaining two laboratories and support areas. In the WTS, Building 41 underground tanks will be removed and the remaining 225 linear feet of underground lines removed.

(e) Reasons for Increases and Decreases

The TPCE has been increased $517,000 from the FY 1986 Congressional Budget data sheet (TPCE = $36,030,000) to reflect year of expenditure dollars. The previously submitted data sheet reflected a TPCE in constant dollars.

Mound ANSPD Areas Decommissioning Project
Albuquerque Operations Office
Dayton Area Office

Total Project Cost Estimate (TPCE): $36,547,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(f) Cost Estimate	Total Cost
1. Operating Expenses:	
a. Decommissioning Operations	$ 34,104
2. Contingency @ approximately 15%	2,443
Total Estimated Cost	$ 36,547

Assumptions:

1. The TPCE assumes a constant level of funding at the current Surplus Facilities Management Program planning level. It also assumes that Nuclear Energy (NE) and the Office of Military Applications (OMA) will continue coordinated program plan funding in order to: effectively utilize resources in areas of joint ownership; follow a logical sequence of decommissioning activities; meet the intent of DOE directives to remove unencapsulated plutonium-238 from Mound; and to prevent shifting of last-user cost responsibilities as agreed to in the NE/OMA Memorandum of Understanding.

2. No funding is required for specific NEPA compliance, as a site-wide Environmental Impact Statement is applicable to this work.

3. The TPCE does not include the costs for maintenance and surveillance activities which may be required beyond completion of remedial actions.

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Monticello Remedial Action and Vicinity Properties Project
Idaho Operations Office
Grand Junction Area Office

Total Project Cost Estimate (TPCE): $37,626,000
(For Engineering, Maintenance and Surveillance,
and Decommissioning Operations)

Monticello Remedial Action and Vicinity Properties Project
Idaho Operations Office
Grand Junction Area Office

Total Project Cost Estimate (TPCE): $37,626,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	Cumulative Prior Years	FY 1985 Actual			FY 1986 Estimate		FY 1987 Estimate	
	Obs.	B/A	Obs.	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):								
Site characterization, engineering	$ 1,394	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
NEPA compliance	345	430	430	505	200	200	0	0
Design and engineering	0	250	250	204	805	851	200	200
Remedial action operations	0	0	0	0	0	0	1,980	1,980
Vicinity properties	481	470	470	666	500	594	600	600
Contingency	0	0	0	0	0	0	850	850
R&D related to construction	0	0	0	0	0	0	0	0
Facility operations	0	0	0	0	0	0	0	0
Direct project related support costs	0	0	0	0	0	0	0	0
Capital equipment	281	35	35	35	48	48	50	50
Total operating expenses	2,501	1,185	1,185	1,410	1,553	1,693	3,680	3,680
Other DOE funding:	0	0	0	0	0	0	0	0
Total DOE funding:	2,501	1,185	1,185	1,410	1,553	1,693	3,680	3,680
Non-DOE funding:	0	0	0	0	0	0	0	0
Total Project funding	$ 2,501	$ 1,185	$ 1,185	$ 1,410	$ 1,553	$ 1,693	$ 3,680	$ 3,680

Monticello Remedial Action and Vicinity Properties Project
Idaho Operations Office
Grand Junction Area Office

Total Project Cost Estimate (TPCE): $37,626,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1988 Estimate		FY 1989 Estimate		FY 1990 Estimate	
	B/A	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):						
Site characterization, engineering	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
NEPA	0	0	0	0	0	0
Design and engineering	0	0	0	0	0	0
Remedial action operations	3,563	3,563	3,465	3,465	3,852	3,852
Vicinity properties	236	236	0	0	0	0
Contingency	1,042	1,042	1,040	1,040	1,119	1,119
R&D related construction	0	0	0	0	0	0
Facility operations	0	0	0	0	0	0
Direct project related support costs	0	0	0	0	0	0
Capital equipment	54	54	58	58	62	62
Total operating expenses	4,895	4,895	4,563	4,563	5,033	5,033
Other DOE funding:	0	0	0	0	0	0
Total DOE funding:	4,895	4,895	4,563	4,563	5,033	5,033
Non-DOE funding:	0	0	0	0	0	0
Total Project funding	$ 4,895	$ 4,895	$ 4,563	$ 4,563	$ 5,033	$ 5,033

Monticello Remedial Action and Vicinity Properties Project
Idaho Operations Office
Grand Junction Area Office

Total Project Cost Estimate (TPCE): $37,626,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1991 Estimate		Thru Completion Estimate		Total Cost
	B/A	B/O	B/A	B/O	B/A
Operating expenses (DOE):					
Site characterization, engineering	$ 0	$ 0	$ 0	0	$ 1,394
NEPA compliance	0	0	0	0	975
Design and engineering	0	0	0	0	1,255
Remedial action operations	3,493	3,493	7,800	7,800	24,153
Vicinity properties	0	0	0	0	2,287
Contingency	870	870	1,950	1,950	6,871
R&D related to construction	0	0	0	0	0
Facility operations	0	0	0	0	0
Direct project related support costs	0	0	0	0	0
Capital equipment	67	67	36	36	691
Total operating expenses	4,430	4,430	9,786	9,786	37,626
Other DOE funding:	0	0	0	0	0
Total DOE funding:	4,430	4,430	9,786	9,786	37,626
Non-DOE funding:	0	0	0	0	0
Total Project funding:	$ 4,430	$ 4,430	$ 9,786	$ 9,786	$ 37,626

Monticello Remedial Action and Vicinity Properties Project
Idaho Operations Office
Grand Junction Area Office

Total Project Cost Estimate (TPCE): $37,626,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

Description, Objective and Justification

The inactive Monticello uranium processing millsite covers approximately 78 acres adjoining the southern limit of Monticello, Utah, townsite. The original mill was financed by the United States Government through its agent, the Defense Plant Corporation, to provide additional sources of vanadium needed during World War II. The Vanadium Corporation of America operated the mill for the Government from 1943 until 1946. The U.S. Atomic Energy Commission (AEC) reactivated the mill in 1948. It was rebuilt and operated for the AEC from 1949 to 1956 by the Galigher Company, and from 1956 through 1959 by the National Lead Company under cost-type contracts to produce both uranium and vanadium.

Mill operations were terminated on January 1, 1960, and the plant was dismantled and excessed by the end of 1964. The mill tailings piles were stabilized from 1961 to 1962, and during 1974-1975 the ore stockpile areas were cleaned up and the mill foundations were buried. In 1975-1976, an additional layer of soil was placed over the tailing piles to prevent further use of the materials as backfill on Monticello private properties. Further remedial actions will be required to bring the millsite's condition to present-day standards of contamination and reclamation.

Initially, the Monticello mill produced vanadium and disposed of the associated uranium in the mill tailings. From 1944 to 1946, the mill produced a uranium-vanadium sludge which was sold to the Manhattan Engineer District for further refining.

Uranium became the Monticello mill's primary product in 1949 when carbonate leaching and yellow cake precipitation and purification stages were added to the original salt roast process which previously had recovered vanadium only.

It is estimated that during its AEC operations, the Monticello mill processed approximately 900,000 tons of ore and produced about 4.6 million pounds of uranium yellow cake. A recent engineering study estimates the amount of tailings and tailings-contaminated material at the Monticello site to be 1.6 million tons, with an additional 400,000 tons of contaminated substrate. Up to 400,000 tons of contaminated material also exists around the millsite as a result of operations related directly to the mill's operations (i.e., windblown and waterborne tailings, ore buying stations, etc.).

Monticello Remedial Action and Vicinity Properties Project
Idaho Operations Office
Grand Junction Area Office

Total Project Cost Estimate (TPCE): $37,626,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

An undetermined volume of contaminated material derived from the millsite was also used for construction purposes throughout the town. Forty-seven properties are currently authorized by DOE for remedial action.

The Monticello Remedial Action Project (MRAP) was accepted into the Surplus Facilities Management Program (SFMP) in 1980 with the task of planning and performing remedial action for the inactive uranium millsite, and vicinity properties in Monticello, Utah.

The Monticello Vicinity Properties Project (MVP) was accepted into the SFMP in 1984 with the task of performing remedial action constructions on contaminated properties in Monticello, Utah.

The primary objective of the project is to eliminate the potential hazard to the public due to long-term exposure to low-level radioactivity and surface and subsurface water contamination associated and derived from the inactive Monticello uranium millsite. A secondary objective is to restore the millsite to a condition that may permit other productive use of the property. It is intended that contaminated materials from the Monticello millsite will be managed and disposed of so as to conform with the appropriate standards.

(a) Schedule of Planned Activities

The following table presents the total project schedule broken down by major activities:

Activity	Start	Complete
Site characterization, engineering	1st Qtr., FY 1981	4th Qtr., FY 1984
NEPA compliance	4th Qtr., FY 1984	3rd Qtr., FY 1986
Design Engineering	4th Qtr., FY 1985	1st Qtr., FY 1987
Remedial Actions	1st Qtr., FY 1987	4th Qtr., FY 1993
Vicinity Properties	2nd Qtr., FY 1984	4th Qtr., FY 1987

Monticello Remedial Action and Vicinity Properties Project
Idaho Operations Office
Grand Junction Area Office

Total Project Cost Estimate (TPCE): $37,626,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(b) Management and Contracting

The DOE Grand Junction Projects Office (GJPO) is responsible for the project management, technical support, and characterization activities. NEPA compliance, design engineering, and support and remedial action activities will be handled by GJPO and appropriate subcontractors. GJPO is also responsible for project management and radiologic engineering assessments for the vicinity properties. Remedial actions construction will be handled by appropriate subcontractors.

(c) Prior Year Achievements

MRAP - During FY 1985 a Final Site Analysis Report (SAR) was completed. It documents the current hydrogeotechnical status of the site and its impact on health and environment. A cost/benefit analysis with primary design concepts compares all the remedial action alternatives. Based on an Action Description Memorandum referencing the SAR and DOE guidelines regarding NEPA compliance, the DOE Assistant Secretary for Policy, Safety and Environment has determined that preparation of an Environment Assessment is appropriate for MRAP. The NEPA compliance documentation was initiated in 1984 and continued through 1985. Further characterizations based on comments from Headquarters on the SAR were implemented in FY 1985. Peripheral properties which were contaminated as a result of offsite windblown and waterborne contamination were characterized. A temporary measure to retard tailings piles saturation, by constructing an interceptor ditch, was completed. The areal hydrologic regime was confirmed. Engineering and environmental monitoring activities continued. A draft Environmental Assessment was scheduled for completion in FY 1985.

MVP - Of the 47 vicinity properties authorized for remedial action, Radiological and Engineering Assessments were scheduled to be completed on 35 properties and 22 remedial action constructions were scheduled to be completed by the end of FY 1985.

(d) Current Year Achievements

MRAP - A final Environmental Assessment is scheduled for completion in early FY 1986. All engineering design efforts are scheduled for completion in FY 1987 and an operating and decommissioning plan in preparation for remedial action construction will be finalized. The remedial action construction activities will be initiated in FY 1987. All property acquisitions and permitting necessary for remedial action will be accomplished. Radiation control and construction monitoring will be implemented. Remedial action activities will be initiated and the peripheral properties decontamination will be accomplished. The construction activities will include excavation of contamination, transportation of contaminated material to the disposal site, and replacement of material with clean fill including restoration of the peripheral properties.

MVP - Remedial action is scheduled to be completed on 7 authorized vicinity properties in FY 1986. In addition, Radiologic and Engineering Assessments are scheduled to be completed for all currently identified vicinity properties. Action on all remaining properties, including all completion and certification documents, is scheduled for completion in early FY 1988.

(e) Reasons for Increases and Decreases

The TPCE for this project has increased by $12,326,000 from the FY 1986 Congressional Budget (TPCE = $25,300,000) data sheet because:

MRAP - As a result of the peripheral property characterization that was completed in FY 1984-85, it was determined that there is approximately 400,000 tons of contaminated material around the millsite directly related to the mill's operations (i.e., windblown and waterborne tailings, ore buying stations, etc.). The cleanup of these peripheral properties increased the cost by approximately $6,000,000 and lengthened the schedule of the MRAP Project.

MVP - Additional costs will also be incurred on the vicinity properties activity, approximately $500,000. The initial remedial action construction experience in FY 1984-1985 proved that a greater than anticipated volume of contamination exists at these properties and resulted in an increase in costs and extended the schedule through FY 1988.

The previously submitted data sheet was done in constant dollars. This data sheet has been revised to reflect year of expenditure dollars, an increase of approximately $5,800,000.

Monticello Remedial Action and Vicinity Properties Project
Idaho Operations Office
Grand Junction Area Office

Total Project Cost Estimate (TPCE): $37,626,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(f) Cost Estimate

		Item Cost	Total Cost
1.	Operating expenses:	$	$ 30,064
	a. Site characterization, engineering	1,394	
	b. NEPA compliance	975	
	c. Design engineering	1,255	
	d. Millsite remedial action	24,153	
	e. Vicinity properties remedial action	2,287	
2.	Capital equipment		691
3.	Contingency @ approximately 20 percent		6,871
	Total Estimated Cost		$ 37,626

Assumptions

1. Based on a Site Analysis survey evaluating three (3) viable options for remedial action on the Monticello Millsite, it was determined that "tailings stabilization in place" would be the most cost beneficial method of eliminating the chronic low-level radiation levels and groundwater contamination for the foreseeable future. However, this does not include active groundwater restoration. If this alternative is selected by DOE, following appropriate NEPA procedures, the Total Project Cost Estimate (TPCE) would be $37,626,000. The other viable options evaluated were alternate site disposal and recovery of residual values:

		Cost Range
a.	Alternate Site Disposal	$ 50,000,000 to $ 70,000,000
b.	Recovery of Residual Value	$ 70,000,000 to $120,000,000

2. Contingency is included at approximately 20 percent due to the large uncertainty in soil contamination.

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(Tabular dollars in thousands. Narrative material in whole dollars.)

Shippingport Station Decommissioning Project
Shippingport, Pennsylvania

Total Project Cost Estimate (TPCE) $98,300,000
(For Engineering, Maintenance and
Surveillance, and Decommissioning Operations)

Shippingport Station Decommissioning Project
Shippingport, Pennsylvania

Total Project Cost Estimate (TPCE) $98,300,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	Cumulative Prior Years	FY 1985 Actual			FY 1986 Estimate		FY 1987 Estimate	
	Obs.	B/A	Obs.	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):								
Engineering & decommissioning								
Conceptual engineering	$ 540	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
Engineering	5,460	0	0	0	0	65	0	0
Decommissioning operations	0	14,214	14,214	9,318	20,203	17,830	19,918	17,365
Contingency	0	1,401	1,401	0	2,392	2,684	1,972	2,605
R&D related to construction	0	0	0	0	0	0	0	0
Facility operations	0	0	0	0	0	0	0	0
Direct project related support costs	0	0	0	0	0	0	0	0
Capital equipment	0	0	0	0	0	0	0	0
Total operating expenses	$ 6,000	$ 15,615	$ 15,615	$ 9,318	$ 22,595	$ 20,579	$21,890	$ 19,970
Other DOE funding:								
Maintenance & Surveillance	3,250	0	0	1,071	0	0	0	0
Total DOE funding:	9,250	15,615	15,615	10,389	22,595	20,579	21,890	19,970
Non-DOE funding:	0	0	0	0	0	0	0	0
Total Project funding	$ 9,250	$ 15,615	$ 15,615	$ 10,389	$ 22,595	$ 20,579	$ 21,890	$ 19,970

Shippingport Station Decommissioning Project
Shippingport, Pennsylvania

Total Project Cost Estimate (TPCE) $98,300,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1988 Estimate		FY 1989 Estimate		FY 1990 Estimate		Total Cost
	B/A	B/O	B/A	B/O	B/A	B/O	B/A
Operating expenses (DOE):							
Engineering & decommissioning							
Conceptual engineering	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 540
Engineering	0	0	0	0	0	0	5,460
Decommissioning operations	13,548	17,762	8,950	14,121	1,437	1,875	78,270
Contingency	2,452	2,664	1,050	1,314	1,513	1,513	10,780
R&D related to construction	0	0	0	0	0	0	0
Facility operations	0	0	0	0	0	0	0
Direct project related support costs	0	0	0	0	0	0	0
Capital equipment	0	0	0	0	0	0	0
Total operating expenses	$ 16,000	$ 20,426	$ 10,000	$ 15,435	$ 2,950	$ 3,388	$ 95,050
Other DOE funding:							
Maintenance & Surveillance	0	0	0	0	0	0	3,250
Total DOE funding:	16,000	20,426	10,000	15,435	2,950	3,388	98,300
Non-DOE funding:	0	0	0	0	0	0	0
Total Project funding	$ 16,000	$ 20,426	$ 10,000	$ 15,435	$ 2,950	$ 3,388	$ 98,300

Shippingport Station Decommissioning Project
Shippingport, Pennsylvania

Total Project Cost Estimate (TPCE) $98,300,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

Description, Objective and Justification

The Shippingport Atomic Power Station (Station) is located on the south bank of the Ohio River in the borough of Shippingport, Beaver County, Pennsylvania, on part of a 486.8-acre tract of land owned by the Duquesne Light Company (DLC). The Station used a pressurized water reactor to generate steam, and was the first nuclear plant in the United States to be used by a public utility to produce electricity. The nuclear reactor portion of the Station operated from 1957 to 1982 under supervision of the Department of Energy (DOE), Office of the Deputy Assistant Secretary for Naval Reactors (NR). The third and final core installed was of the light water breeder reactor (LWBR) type. The Station was shutdown and permanently disconnected from the power grid on October 1, 1982, after sufficient data from the LWBR core had been obtained. Following a planned period of defueling and end-of-life testing, the Station was transferred in September 1984, to the Office of Terminal Waste Disposal and Remedial Action Programs, DOE-HQ, for decommissioning. The decommissioning mode has been officially selected as prompt removal/dismantlement based primarily on the NEPA process. That mode is the basis for this request.

The purpose of the Shippingport Station Decommissioning Project (SSDP) is to place the Station in a long-term radiologically safe condition following defueling of the reactor (as agreed by the Government in contract #E(36-1)-292 with DLC), to demonstrate to the nuclear industry the practical and affordable dismantlement of a large nuclear power plant, and to provide useful data for future decommissioning projects. The Station was the first large scale central station nuclear power plant in the United States and was funded jointly by a predecessor agency to DOE (Atomic Energy Commission) and the Duquesne Light Company of Pittsburgh. It was operated for DOE-NR by the Duquesne Light Company. Decommissioning of the Station is the final phase of this long term reactor development and demonstration program. The SSDP will make the nuclear portion of the Station radiologically safe, and will remove government-owned portions of the plant including components and equipment. Thus, the SSDP directly supports DOE's mission by demonstrating the economic and technical feasibility of decommissioning a commercial nuclear power plant. The SSDP will be accomplished with minimum environmental impact and will result in restoring the reactor site radiologically to unrestricted use. The prompt removal/dismantling mode is the most cost-effective mode.

Shippingport Station Decommissioning Project
Shippingport, Pennsylvania

Total Project Cost Estimate (TPCE) $98,300,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(a) Schedule of Planned Activities

The following table presents the total program broken down by primary tasks.

Activity	Start	Complete
Conceptual Engineering	2nd Qtr., FY 1979	1st Qtr., FY 1981
Design Engineering	1st Qtr., FY 1981	4th Qtr., FY 1983
Follow-on Design Engineeri.	1st Qtr., FY 1984	3rd Qtr., FY 1984
Maintenance & Surveillance	4th Qtr., FY 1984	4th Qtr., FY 1985
Decommissioning	4th Qtr., FY 1985	1st Qtr., FY 1990
Project Completion/Site Release		2nd Qtr., FY 1990

(b) Management and Contracting

Project management is provided by DOE-Richland Operations Office (RL). Technical, cost and schedule management support for the project is provided by UNC Nuclear Industries (UNC). Burns and Roe Industrial Services Corporation (BRISC), with Nuclear Energy Services, Inc. (NES) as principal subcontractor, performed the engineering services for the planning of the SSDP under contract to RL. The General Electric Company, with Morrison-Knudsen as a principal subcontractor, was selected as the Decommissioning Operations Contractor (DOC) and is responsible for management and performance of physical decommissioning.

(c) Prior Year Achievements

The mission need, project objective, and initiative of project activity was approved on November 2, 1979. The final Environmental Impact Statement (EIS) was approved in May 1982. The Department selected the prompt dismantlement mode for decommissioning in August 1982 and announced this decision in the Federal Register.

Conceptual and design engineering was completed by October 1983 and follow-on design engineering was completed in the third quarter of FY 1984. The process to competitively select the DOC was completed in FY 1983 and a contract was entered into in FY 1984. The maintenance and surveillance period began in FY

Shippingport Station Decommissioning Project
Shippingport, Pennsylvania

Total Project Cost Estimate (TPCE) $98,300,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

1984 and was completed at the end of the first quarter of FY 1985. DOE, UNC, and GE project personnel relocated to the Shippingport Site in FY 1984, to initiate site and project management activities. In FY 1985 detailed engineering, planning, and preparation of bid specifications for initial subcontracted activities were initiated by GE. DOC and subcontractor tasks specific to preparation of the site for decommissioning were started; miscellaneous decontamination work began; and physical decommissioning was initiated by removal of: several primary system components, asbestos insulation, and plant water inventory.

(d) Current Year Achievements

In FY 1986, asbestos removal, transfer of irradiated components and site preparations will be completed. DOC subcontractors will continue removal of the primary components with piping and equipment removal work following close behind. Plant water inventory will continue to be processed and discharged, and decontamination work will continue on an as-required basis.

(e) Reasons for Increases and Decreases

No change from previously submitted FY 1986 schedule 47.

Shippingport Station Decommissioning Project
Shippingport, Pennsylvania

Total Project Cost Estimate (TPCE) $98,300,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(f) Cost Estimate

	Item Cost	Total Cost
1. Operating Expenses: Design and Construction (Engineering and Decommissioning)	$	$ 84,270
a. Conceptual Engineering	540	
b. Engineering	5,460	
c. Procurement	562	
d. Decommissioning Operations	77,708	
2. Contingency @13.8% of decommissioning operations and procurement (items 1.c. and 1.d.)		10,780
3. Maintenance and Surveillance		3,250
Total Estimated DOE Cost		$ 98,300

Assumptions

1. The TPCE assumes completion of physical decommissioning in the 1st quarter FY 1990 and all effort completed in the 2nd quarter FY 1990.

2. Assumed labor rates in the TPCE are based on Department of Labor (DOL) wage determinations that are subject to a current DOL area wage survey. There is a high probability that wages associated with Service Contract Act work will increase significantly. This would result in a major change to the TPCE.

DEPARTMENT OF ENERGY
FY 1987 CONGRESSIONAL BUDGET REQUEST
OPERATING EXPENSE FUNDED PROJECT DATA SHEET
NUCLEAR ENERGY

Energy Supply Research and Development
Remedial Action and Waste Technology

(Tabular dollars in thousands. Narrative material in whole dollars.)

West Valley Demonstration Project
West Valley, New York

Total Project Cost Estimate (TPCE)
Phase I: $442,370,000 a/
Phase II: TBD b/

a/ Phase I costs include project development, design construction, operating, and decontamination and decommissioning activities through waste solidification. Project cost stated in year of expenditure dollars (TPCE in constant FY 1985 dollars is $366,000,000; corresponds to TPCE of $285,000,000 in September 1980 dollars, date of enactment of P.L. 96-368.) The TPCE revised from previous estimate of $436,330,000 to accommodate revised FY 1987 availability.

b/ Phase II costs include post-solidification operating, high-level waste storage and transportation, and final decontamination and decommissioning activities. A definitive estimate for the post-solidification phase (e.g., waste storage and transportation and final decontamination and decommissioning) will be prepared after coordination with the Nuclear Regulatory Commission and the State of New York and preparation of appropriate environmental documents. A preliminary, scoping cost estimate for the post-solidification phase is being prepared and the estimated range of costs is between $250,000,000 and $350,000,000, depending on decommissioning alternative selected.

West Valley Demonstration Project
West Valley, New York

Total Project Cost Estimate (TPCE): $442,370,000 a/

(Tabular dollars in thousands. Narrative material in whole dollars.)

	Cumulative Prior Years	FY 1985 Estimate			FY 1986 Estimate		FY 1987 Estimate	
	Obs.	B/A	Obs.	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):								
Waste solidification	$ 20,550	$ 21,450	$ 21,450	$ 21,450	$ 29,781	$ 29,781	$ 33,750	$ 33,750
Decontamination and decommissioning	7,100	5,410	5,410	5,410	4,670	4,670	4,300	4,300
Site operations	15,832	9,080	9,080	9,080	10,900	10,900	12,450	12,450
Direct project related support costs	6,110	2,440	2,440	2,440	2,950	2,950	3,500	3,500
Low-level and TRU waste handling	9,170	8,770	8,770	8,770	13,280	13,280	25,000	25,000
Total operating expenses	58,762	47,150b/	47,150	47,150	61,581	61,581	79,000	79,000
Other DOE funding:								
Capital equipment	1,200	0	0	0	0	0	0	0
General plant projects	1,500	0	0	0	0	0	0	0
Total DOE funding:	61,462	47,150	47,150	47,150	61,581	61,581	79,000	79,000
Non-DOE funding:c/								
NYSERDA	953	1,175	1,175	1,175	2,600	2,600	3,160	3,160
Total Project funding	$ 62,415	$ 48,325	$ 48,325	$ 48,325	$ 64,181	$ 64,181	$ 82,160	$ 82,160

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a/ Does not include post-solidification (e.g., waste storage and transportation and final decontamination and decommissioning) costs

b/ Reduction from the FY 1985 Appropriation of $49,400,000 due to general reduction ($1,500,000) and management initiative ($750,000).

c/ Represents an estimate of project activities funded by the New York State Energy Research and Development Authority (NYSERDA). Other NYSERDA contributions include value of Western New York Nuclear Service Center and NYSERDA services.

West Valley Demonstration Project
West Valley, New York

Total Project Cost Estimate (TPCE): $442,370,000 a/

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1988 Estimate		FY 1989 Estimate		FY 1990 Estimate		Total Cost a/
	B/A	B/O	B/A	B/O	B/A	B/O	B/A
Operating expenses (DOE):							
Waste solidification	$ 27,200	$ 27,200	$ 21,220	$ 21,220	$ 11,659	$ 11,659	$165,610
Decontamination and decommissioning	6,610	6,610	6,600	6,600	6,700	6,700	41,390
Site operations	15,380	15,380	17,800	17,800	17,000	17,000	98,442
Direct project related support costs	3,550	3,550	3,580	3,580	4,580	4,580	26,710
Low-level and TRU waste handling	9,960	9,960	11,100	11,100	8,150	8,150	85,430
Total operating expenses	62,700	62,700	60,300	60,300	48,089	48,089	417,582
Other DOE funding:							
Capital equipment	0	0	0	0	0	0	1,200
General plant projects	0	0	0	0	0	0	1,500
Total DOE funding:	62,700	62,700	60,300	60,300	48,089	48,089	420,282
Non-DOE funding:b/							
NYSERDA	5,790	5,790	5,240	5,240	3,170	3,170	22,088
Total Project funding	$ 68,490	$ 68,490	$ 65,540	$ 65,540	$ 51,259	$ 51,259	$442,370

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a/ Does not include post-solidification (e.g. waste storage and transportation and final decontamination and decommissioning) costs

b/ Represents an estimate of project activities funded by the New York State Energy Research and Development Authority (NYSERDA). Other NYSERDA contributions include value of Western New York Nuclear Service Center and NYSERDA services.

West Valley Demonstration Project
West Valley, New York

Total Project Cost Estimate (TPCE): $442,370,000 a/

(Tabular dollars in thousands. Narrative material in whole dollars.)

Project Cost Sharing Estimate

Total Project Cost Estimate:

Department of Energy	$420,282
New York State direct expenditures and cash payments of the Project	22,088
Total Project Cost Estimate	$442,370 a/

New York State Contribution:

(a)	Design, construction, etc. (direct expenditures and cash payments)	$ 22,088
(b)	New York State Energy Research and Development Authority Credit and Services	24,500 b/
	Total NYSERDA Contribution	$ 46,588 c/

Description, Objective and Justification

Public Law 96-368, West Valley Demonstration Project Act of 1980, directed the Department of Energy to carry out a high-level liquid nuclear waste management demonstration project at the Western New York Nuclear Service Center near West Valley, New York, for the purpose of demonstrating the solidification and preparation of high-level radioactive waste for disposal. By virtue of demonstrating the solidification of liquid high-level wastes, the hazards associated with continued storage of the liquid waste at the Center will be eliminated.

The Center reprocessed nuclear fuel from 1966 to 1972. During that time, approximately 560,000 gallons of alkaline high-level waste was generated by this activity and stored in a carbon steel tank located in an underground vault. The alkaline waste is similar to that stored at the Department's Savannah River and Hanford sites in that these wastes also consist of a supernatant liquid and a sludge that has formed on the

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a/ Does not include post-solidification (e.g., waste storage and transportation and final decontamination and decommissioning) costs.

b/ Includes Facility Credit of $16,100,000; other Authority Services total $8,400,000.

c/ Elements that make up the Total Cost per Cooperative Agreement total $465,370,000 (i.e., DOE and NYSERDA Direct Costs, Facility Credit, and Other Authority Services). NYSERDA's 10 percent share is $46,588,000.

tank bottom. A smaller amount (about 12,000 gallons) of acidic Thorex waste, stored in a stainless steel tank located in a separate underground concrete vault, will also be treated. The project scope includes all activities undertaken in carrying out the solidification, including: (1) preparation of the Center's premises and facilities to accommodate the solidification project, including such decontamination of existing facilities and equipment as may be necessary or appropriate; (2) removal of the wastes from the underground storage tanks; (3) development, design, construction, and operation of systems and necessary supporting facilities for the solidification of the wastes; (4) acquisition of containers for the permanent disposal of the solidified waste; (5) temporary storage of the solidified waste followed by transportation to an appropriate Federal repository for permanent disposal; (6) decontamination and decommissioning (D&D) of the waste tanks and facilities, material, and hardware used in carrying out the solidification of the wastes; and (7) disposal of low-level and transuranic wastes produced from project activities.

Since existing facilities and utilities will be used to support this project, site improvements and utility (water, electrical, and sewer) upgrading will be minimal. Utilization of existing facilities will be maximized and new construction kept to a minimum consistent with programmatic, environmental, health, and safety needs. A limited amount of new facilities and modifications and/or additions to existing facilities are included to accommodate installation and operation of the solidification equipment and to provide necessary office space and support for these activities.

Operating expense funds will be used to fund development, design, construction, site/facility operation, and decontamination and decommissioning activities associated with the project.

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a/ Does not include post-solidification (e.g., waste storage and transportation and final decontamination and decommissioning) costs.

West Valley Demonstration Project
West Valley, New York

Total Project Cost Estimate (TPCE): $442,370,000 a/

(Tabular dollars in thousands. Narrative material in whole dollars.)

(a) Schedule of Planned Activities b/

Activity	Start	Complete
Design, procurement and fabrication of Component Test Stand	2nd Qtr. FY 1983	4th Qtr. FY 1985
Component Test Stand operation	4th Qtr. FY 1985	4th Qtr. FY 1986
Supernatant Processing	1st Qtr. FY 1987	1st Qtr. FY 1988
Upgrade test stand for radioactive operation	4th Qtr. FY 1985	3rd Qtr. FY 1988
Vitrification facility checkout and cold operation	3rd Qtr. FY 1988	1st Qtr. FY 1989
Vitrification of high-level waste	2nd Qtr. FY 1989	4th Qtr. FY 1990
Post-vitrification decontamination and decommissioning	3rd Qtr. FY 1990	Open

(b) Management and Contracting

The project is managed for the Department by an onsite project office, reporting through the Idaho Operations Office, which is responsible for the day-to-day management and decisionmaking. An operating contractor (West Valley Nuclear Services Company, Inc., a wholly owned subsidiary of Westinghouse Electric Corporation) is responsible for the technical management of the high-level waste solidification related activities, site and facility operations, and decontamination and decommissioning. Approval by the Department's Field, Project and Headquarters Offices is required on matters affecting project policies and technical, cost, and schedule baselines. The State of New York through the New York State Energy Research and Development Authority provides consultation and comment on project activities to the Department as required by the West Valley Demonstration Project Act and the cooperative agreement between the Department and the Authority. An architect/engineering (A/E) firm (Ebasco Services, Inc.) has been selected by the operating contractor to perform miscellaneous A/E services; the Department reviewed and

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a/ Does not include post-solidification (e.g., waste storage and transportation and final decontamination and decommissioning) costs.

b/ Based on reference schedule, solidification is anticipated to take about 18 months beginning in FY 1989 followed by completion of decontamination and decommissioning activities in the early 1990's.

approved the selection process and contract terms. The architect-engineer scope of work generally includes preliminary and final design. To the extent feasible, design, procurement, construction, and inspection will be by fixed-price contract and subcontracts awarded on the basis of competitive bids. However, due to the complexity of the work, it may be necessary to utilize cost plus fixed fee contracts for portions of the work. Award fee contracts will be used when justified. Contracting will be by the Department or the operating contractor, depending on the nature and scope of work. The project is supported by the Battelle Pacific Northwest Laboratory, Richland, Washington, for development activities required to adapt waste treatment and solidification technology for the specific West Valley situation.

(c) Prior Year Achievements

The delivery of the melter/turntable was completed and services installed. The melter/turntable was operational in December 1984 and produced a full-scale, simulated test canister. An evaluation of the alternate locations for the vitrification system was completed and the design for the upgrades necessary to convert the Component Test Stand for radioactive operation was initiated. The test stand was operated using simulated West Valley waste compositions to verify component performance and to provide samples for product qualification. Installation and checkout of equipment for the liquid low-level waste cement solidification system were completed. Design of the balance of the liquid low-level waste treatment system was completed and procurement and installation of components were initiated. Final design of the supernatant treatment and waste transfer systems was completed. Procurement of all major supernatant treatment equipment was begun. Testing of waste removal equipment in the 1/6 scale waste tank model continued. The waste vitrification development program will focus on verification of applicable technology with emphasis on the following areas: completion of supernatant and sludge sampling and characterization, demonstration of waste form behavior, interaction with the Office of Civilian Radioactive Waste Management on waste disposal criteria and specifications, and testing to ensure acceptability of the West Valley immobilized waste.

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a/ Does not include post-solidification (e.g., waste storage and transportation and final decontamination and decommissioning) costs.

West Valley Demonstration Project
West Valley, New York

Total Project Cost Estimate (TPCE): $442,370,000 a/

(Tabular dollars in thousands. Narrative material in whole dollars.)

(d) Current Year Achievements

Scale model equipment testing will continue in FY 1986 and design for sludge mobilization will be completed. High-level waste (HLW) transfer piping and monitoring systems from waste tanks 8D-2 and 8D-4 to the Component Test Stand, and pump/piping connection arrangement for the containment pit will be designed in FY 1986. All major procurements for supernatant treatment will be received and modifications to existing facilities will be completed in fourth quarter FY 1986. System operation is scheduled to begin in March of 1987. Decontamination of cell areas needed for the liquid radioactive waste treatment system equipment will be completed in the first quarter FY 1986 in preparation for modifications and installation. Equipment procurement and installation/checkout will support an FY 1987 system startup of the liquid radioactive waste treatment system. Removal of jumpers and vessels from the Chemical Process Cell will be finished. Major refurbishment work in the Fuel Receiving and Storage Area will begin in the fourth quarter of FY 1986 to support installation of size reduction and TRU decontamination systems. Cement solidification will be operational and civil construction and equipment procurement for supernatant treatment and liquid waste treatment to support sludge mobilization and vitrification in FY 1987 and 1989, respectively, will be completed.

(e) Reasons for Increase and Decreases

The FY 1985 and FY 1986 Congressional data sheet showed a Phase I total project estimate of $472,800,000. The FY 1987 request shows a reduction in the Total Project Cost Estimate of approximately $30,000,000. Revised FY 1987 budget availability has led to a further revision with the current estimate now being $442,370,000.

(f) Cost Estimate

The costs shown are based on planned expenditures through FY 1990. A baseline cost and schedule estimate through waste solidification has been prepared. These current estimates include the following types of costs associated with the West Valley project: development, design, construction, waste immobilization,

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a/ Does not include post-solidification (e.g., waste storage and transportation and final decontamination and decommissioning) costs.

West Valley Demonstration Project
West Valley, New York

Total Project Cost Estimate (TPCE): $442,370,000 a/

(Tabular dollars in thousands. Narrative material in whole dollars.)

decontamination and decommissioning of existing hot cells for project reuse, site/facility operation and maintenance, project management, and low-level and transuranic waste handling. The cost estimate will be updated to include final decontamination and decommissioning (D&D), HLW transportation, and other activities when sufficient information is available.

	Total Cost 1/
High-Level Waste Solidification	$171,509
Decontamination and Decommissioning	47,656
Site operations	109,892
Direct Project Related Support	26,710
Low-level and TRU Waste Handling	83,903
Capital Equipment	1,200
General Plant Projects	1,500
Total Project Cost Estimate	$442,370

High-Level Waste Solidification

This category provides for development, design, construction, and operating activities related to immobilization and preparation of the high-level waste for permanent disposal.

(1) Development - includes confirmatory of prototype development program, including Component Test Stand and mockups. This activity is based on adapting existing technology from the base Nuclear Energy and Defense waste management programs to meet specific West Valley requirements.

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a/ Does not include post-solidification (e.g., waste storage and transportation and final decontamination and decommissioning) costs.

Total Project Cost Estimate (TPCE): $442,370,000 a/

(Tabular dollars in thousands. Narrative material in whole dollars.)

(2) Design - includes conceptual, preliminary and final design, inspection services, system(s) acceptance testing, and facility startup.

(3) Building and structures - includes modification and construction of facilities (e.g., Component Test Stand) for waste solidification and supporting systems/activities, field offices, and storage sheds.

(4) Special equipment - includes waste removal, transfer, solidification, and other systems necessary to carry out the waste immobilization and supernatant treatment program.

(5) Operating - includes labor and material costs, including steel canisters, for the waste processing operations.

Decontamination and Decommissioning

This category covers the planning, engineering, equipment, and operations necessary for project D&D. It provides for the initial decontamination to prepare contaminated areas and hot cells for reuse by the project.

Site Operations

This category includes site/facility operations, training, maintenance, restoration, and upgrades (e.g., electrical and water supply system, roads, roofs, etc.) necessary to support waste solidification, decommissioning, environmental and occupational safety, security and safeguards requirements.

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a/ Does not include post-solidification (e.g., waste storage and transportation and final decontamination and decommissioning) costs.

West Valley Demonstration Project
West Valley, New York

Total Project Cost Estimate (TPCE): $442,370,000 a/

(Tabular dollars in thousands. Narrative material in whole dollars.)

Direct Project Related Support

This category provides for technical, administrative, and overall management control of the project. Activities preformed support other project elements and include items such as cost/schedule control systems, project reports, quality assurance program, public communication program, and records management.

Low-Level and TRU Waste Handling

This category includes the Cement Solidification and Liquid Waste Treatment systems for low-level waste disposal; Size Reduction and TRU Decon Facility and TRU Interim Storage Facility for handling of TRU waste generated in the decontamination and decommissioning of the process building for reuse; and project radiological safety and control support activities.

Capital Equipment

This category provides equipment used in initial site takeover operations and restoration activities, such as health physics and environmental monitoring instrumentation and equipment, decontamination and decommissioning tools and equipment, manipulators and hot cell lights, and analytical chemical laboratory equipment.

General Plant Projects

This category provides for miscellaneous small construction and improvement projects, such as installation of a meteorological and environmental monitoring laboratory, construction of a low-level/transuranic waste sorting facility, construction of a facility to protect the component test stand, and upgrade of the low-level waste treatment facility and laundry.

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a/ Does not include post-solidification (e.g., waste storage and transportation and final decontamination and decommissioning) costs.

DEPARTMENT OF ENERGY
FY 1987 CONGRESSIONAL BUDGET REQUEST
PROGRAM OVERVIEW
Civilian Radioactive Waste Research and Development

This overview document describes the Civilian Radioactive Waste Research and Development (R&D) program within the Department of Energy. The Civilian Radioactive Waste R&D program provides for encouraging and expediting the availability of licensed new at-reactor storage technologies. As required by the Nuclear Waste Policy Act (NWPA), the program objectives are to be accomplished through the use of Federal funds appropriated to the Secretary to carry out existing legislative R&D activities; as well as those established by Sections 135, 136, 218 and 223 of the NWPA. No funds are requested for research and development concerning alternatives for the permanent disposal of high-level radioactive wastes, including subseabed methods. Accordingly, activities to implement Section 222 of the NWPA will be terminated after FY 1986.

Implementation Strategy

The Department's Spent Fuel Storage Development subprogram efforts are to utilize all means directed or available through the Act or other authority to encourage and expedite the most efficient use of existing storage facilities and the addition of new capacity in a timely fashion. The primary means for accomplishing this under the Act are:

(1) To establish, in cooperation with the private sector, a demonstration program for the dry storage of spent nuclear fuel at civilian nuclear power reactor sites with the objective of establishing one or more technologies that the Nuclear Regulatory Commission (NRC) may, by rule, approve for use by the industry, [Section 218(a)].

(2) To undertake a cooperative program with the private sector to encourage the development of spent fuel rod consolidation technologies in existing power reactor water storage basins, [Section 218(a)].

(3) To provide consultative and technical assistance on a cost sharing basis to the private sector for the design support and generic licensing documentation required by the Nuclear Regulatory Commission (NRC) to permit construction authorization and licensing for onsite dry storage technologies, [Section 218(a)].

(4) To establish a cost shared development program at Federal facilities for not more than 300MT of spent fuel to collect necessary data to assist the utilities involved in the licensing process, [Section 218(c)(1)].

(5) To provide generic research and development of alternative spent nuclear fuel storage technologies to enhance utility provided, at-reactor storage capabilities, [Section 218(b)(3)].

(6) To cooperate with Non-Nuclear Weapon States (NNWS) by providing technical assistance in the field of spent fuel storage [Section 223].

(7) To provide the planning for full cost recovery program for the Federal Interim Storage (FIS) of not more than 1900 metric tons of storage capacity which could be activated if requested by an owner or operator of a power reactor and upon a determination by the NRC that despite diligent pursuit of licensed alternatives, adequate storage capacity cannot be found and the continued orderly operation of the reactor plant is threatened, [Section 135 and 136].

Highlights

Some of the near-term highlights and accomplishments of the Civilian Radioactive Waste R&D program are segregated by the three major subprograms which are summarized below for the Spent Fuel Storage Development Subprogram and Alternate Disposal Concepts Subprogram in FY 1986; and for the Spent Fuel Storage Development Subprogram in FY 1987:

FY 1985 accomplishments include:

Spent Fuel Storage Development

- Initiated dry storage cooperative demonstration and testing at Idaho National Engineering Laboratory (INEL) for the DOE/Virginia Power (VP) program for dry storage cask demonstration and loaded a dry storage cask at INEL with 21 spent fuel assemblies shipped from VP-Surry Power Plant.
- Installed rod consolidation equipment at Brown's Ferry fuel storage pool as part of the interagency agreement with the Tennessee Valley Authority (TVA) for an in-pool rod consolidation demonstration.
- Participated in international activities with the International Atomic Energy Agency (IAEA), Nuclear Energy Agency (NEA) and under an existing bilateral bilateral agreement with the Federal Republic of Germany (FRG).
- Provided support to Carolina Power and Light for their license application to the NRC.
- Activities were initiated at INEL to store and monitor the transportable, dry storage casks being used in the cooperative demonstration with the Nuclear Fuel Services, Inc.
- Completed cask characterization tests with intact fuel in inert cover gas for a DOE owned REA 2023 Storage Cask.
- Issued annual update of Spent Fuel Storage Requirements Report.
- Issued annual update of Federal Interim Storage fee charges and deployment plans.
- Applied to NRC for certification of casks for the shipment of Nuclear Fuel Services (NFS) fuel at West Valley to INEL.
- Cooperated with several NNWS by providing them with information in the area of spent fuel storage.

Alternative Disposal Concepts

- Issued working radiologic guidelines and standards for systems analysis of radiological safety of subseabed disposal.
- Completed construction of the In Situ Heat Transfer Experiment test platform and components and demonstrated its deployment and recovery in preparation for FY 1986 in situ tests.
- Completed the analysis of sediments acquired by the Deep Sea Drilling Program from two North Pacific site study areas.

- Completed the field data collection of geophysical characteristics of the two Atlantic site study areas.

- Completed the planning and construction of a test rig for assessment of hole self-closure following emplacement of containers in the subseabed.

- Completed plans for subseabed sediment deep core samples to characterize deep sediments.

- Participated in the NEA Seabed Working Group.

- Completed biological and ocean models for migration of radionuclides by acquiring geotechnical and biological samples of the potential sites to confirm models.

Generic Methods and Supporting Studies

- Submitted the final report on alternative approaches to managing the construction and operation of all civilian radioactive waste management facilities to Congress, otherwise known as the AMFM panel report.

- Updated and reissued through 1987, the required annual notice offering technical assistance to nonnuclear weapon states.

- Cooperated with NNWS in the area of waste disposal.

- Continued research under university research and fellowship programs, and coordinated ongoing and completed research with appropriate technical staff to incorporate into technical base of waste management activities.

- Supported efforts of other governmental agencies and independent groups that are relevant to technical and programmatic activities in the areas of spent fuel storage and waste disposal.

Expected FY 1986 accomplishments include:

Spent Fuel Storage Development

- The completion of the licensed construction and use of horizontal silo dry storage modules at Carolina Power and Light's H.B. Robinson site under the cooperative program.

- Complete the loading of two dry storage casks at INEL with the Virginia Power spent fuel.

- Complete the shipping and receiving of two dual purpose, transportable, dry storage casks at INEL. These casks will be NRC certified.

- Publish the documentation on the technical basis for the licensing of dry storage of spent fuel in an air atmosphere.

- Complete the consolidation of several assemblies owned by Rochester Gas and Electric and stored at the West Valley Pool. These consolidated assemblies will be shipped back to the RG&E Ginna plant for storage.

- Complete the documentation required for NRC evaluation and qualification of computer codes to predict thermal behavior of spent fuel in dry storage casks.

- Complete installation of new equipment and verification of existing facilities at INEL for the dry rod consolidation activities associated with the VP cooperative program.
- Issue the annual update of Spent Fuel Storage Requirements Report.
- Issue Federal Interim Storage Deployment Report.
- Publish the annual Federal Interim Storage Fee Schedule in the Federal Register.
- Continue cooperative activities for information exchange on spent fuel storage with the non-nuclear weapon states.
- Continue to participate in international activities with the IAEA, NEA and the FRG.

Alternative Disposal Concepts

- The subseabed activities, which were the Department's only effort to conduct research and development on alternative nuclear waste disposal concepts as provided by Section 222 of the NWPA, will be terminated after FY 1986. Accordingly, the following activities will be brought to a close during FY 1986:
- Seafloor topographic mapping of the two Atlantic site study areas.
- Deployment of the one-year in Situ Heat Transfer Experiment on the sea floor to determine sediment and pore water behavior during heating.
- The assessment of potential near-field sediment chemical reactions of reference waste and canister materials.
- The biological radiosensitivity assessment of deep ocean organisms as a basis for radiological tolerance.
- Development of a site specific ocean circulation model.
- Collection of long-core sediment samples from the two Atlantic study areas in order to characterize deep sediments.
- Preliminary tests on self-closure of holes in sediment following simulated emplacement of waste canisters.
- Participation in the NEA Seabed Working Group.

Expected FY 1987 accomplishments include:

Spent Fuel Storage Development

- continue dry storage cask testing at INEL in conjunction with Virginia Power.
- Complete preliminary tests and analyze results from Carolina Power and Light's Nutech Horizontal Module System transport cask.
- Complete preliminary tests and analyze results from the Tennessee Valley Authority's GNS CASTOR 1C cask at Browns Ferry, if the TVA continues this activity under the Interagency Agreement.

- Begin consolidation demonstrations of spent fuel in a cooperative project with Northeast Utilities Services Company in their Millstone II reactor spent fuel pool.
- Issue updated topical report on "The Design Basis for Storage of Spent Fuel in Air."
- Publish annual Federal Interim Storage Fee Schedule in Federal Register.
- Issue Federal Interim Storage Deployment Plan to Congress.
- Issue updated Spent Fuel Storage Requirements Report.
- Continue cooperative activities in information exchange spent fuel storage with the non-nuclear weapon states.
- Continue to participate in international activities with the IAEA, NEA and the FRG.

DEPARTMENT OF ENERGY
FY 1987 CONGRESSIONAL BUDGET REQUEST
LEAD TABLE
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT
ENERGY SUPPLY RESEARCH AND DEVELOPMENT ACTIVITIES
(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1985 Appropriation	FY 1986 Appropriation	FY 1987 Base	FY 1987 Request	Request vs Base
Civilian Radioactive Waste Research and Development (OCRWM)					
Spent Fuel Storage Development					
Operating expenses...........	$11,465	$ 7,496	$ 7,496	$ 6,300	$-1,196
Capital equipment............	1,000	1,058	1,058	---	-1,058
Subtotal.....................	12,465	8,554	8,554	6,300	-2,254
Alternative Disposal Concepts					
Operating expenses...........	9,830	5,292	5,292	---	-5,292
Capital equipment............	1,500	1,915	1,915	---	-1,915
Subtotal.....................	11,330	7,207	7,207	---	-7,207
Generic Methods and Supporting Studies					
Operating expense............	1,825	---	---	---	---
Subtotal.....................	1,825	---	---	---	---
Program Direction					
Operating expenses...........	266	303	303	200	103
Subtotal.....................	266	303	303	200	-103
Total					
Operating expense............	23,386	13,091	13,091	6,500	-6,591
Capital equipment............	2,500	2,973	2,973	---	-2,973
Grand Total..................	$25,886a/	$16,064b/	$16,064b/	$ 6,500	$-9,564
Staffing Total FTE............	4	5	5	3	-2

Authorization: Sec. 31, P.L. 83-703 and P.L. 97-425.

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a/ Reflects General Reduction of $660,000; ADP Reduction of $550,000; and savings from management initiatives of $343,000 per Congressional Directive in Conference Report (H. Rept. 98-866) to P.L. 98-360, and $201,000 transferred to the Office of Energy Research (OER) for Small Business Innovation Research (SBIR) activities in FY 1985, in accordance with P.L. 97-219.

b/ Reflects a General Reduction of $30,000 and a reduction of $631,000 in compliance with the Gramm-Rudman-Hollings deficit reduction act, PL 99-177. Details of the reductions are provided on the attached table.

DEPARTMENT OF ENERGY

FY 1987 CONGRESSIONAL BUDGET REQUEST

Adjustments to FY 1986 Appropriations
(dollars in thousands)

	FY 1986 Appropriation	Gramm-Rudman-Hollings	General Reduction	Management Initiatives	DOE Wide FTE Reduction	Pay Restoration	Subtotal	Comparability Adjustments	Total
Civilian Radioactive Waste Research and Development									
Spent Fuel Storage Development									
Operating expenses...........	$ 7,800	-294	-10	---	---	---	---	---	$ 7,496
Capital equipment............	1,100	-42	---	---	---	---	---	---	1,058
79-1P-AFR FAC................	---	---	---	---	---	---	---	---	---
Subtotal.....................	8,900	-336	-10	---	---	---	---	---	8,554
Alternative Disposal Concepts									
Operating expenses...........	5,500	-208	---	---	---	---	---	---	5,292
Capital equipment............	2,000	- 75	-10	---	---	---	---	---	1,915
Subtotal.....................	7,500	-283	-10	---	---	---	---	---	7,207
Generic Methods and Supporting Studies									
Operating expense............	---	---	---	---	---	---	---	---	---
Subtotal.....................	---	---	---	---	---	---	---	---	---
Program Direction									
Operating expenses...........	325	-12	-4	---	-6	---	---	---	303
Subtotal, Civilian Waste R&D.	$16,725	$ -631	$ -24	$ ---	$ -6	$ ---	$ ---	$ ---	$16,064

DEPARTMENT OF ENERGY
FY 1987 CONGRESSIONAL BUEGET REQUEST
SUMMARY OF CHANGES
CIVILIAN RADIOACTIVE WASTE RESEARCH AND DEVELOPMENT
(In thousands of dollars)

FY 1986 Appropriation Enacted....................................	$16,064
Build in increases and decreases:	
Transfer to OER for SBIR activities............................	-72
FY 1987 Base..	$15,992
Program increases and decreases:	
Escalation increase..	+ 690
Spent Fuel Storage Development	
Provides for a coordinated implementation of cooperative projects and supporting R&D for NRC generic decision making process.....	- 2,555
Alternative Disposal Concepts	
Terminates the subseabed disposal subprogram..................	- 7,524
Program Direction	
Reduction resulting from reduction to FTES....................	- 103
FY 1987 Budget Request	$ 6,500

DEPARTMENT OF ENERGY
FY 1987 CONGRESSIONAL BUDGET REQUEST
CIVILIAN RADIOACTIVE WASTE RESEARCH AND DEVELOPMENT
(Budget Authority in Thousands)

FY 1985 Appropriation	FY 1986 Appropriation	FY 1987 Request
$25,886	$16,064	$ 6,500

Civilian Radioactive Waste Research and Development

The Civilian Radioactive Waste R&D Program is comprised of generic research, cooperative agreement activities, Federal Interim Storage planning and information exchange with NNWS consistent with the Nuclear Waste Policy Act (NWPA). Some of these activities were in progress prior to passage of the Act and others were new initiatives. All of these activities have now been integrated to avoid duplication and to carry out the requirements of the NWPA and other related waste management initiatives.

The R&D activities will be conducted for the purpose of providing or supplementing the technical data base for safe storage and transport of spent fuel; for utility licensing activities; for rulemakings; and for Federal Interim Storage.

Title II of the NWPA P.L. 97-425, pertains to the research, development, and demonstration activities relevant to the disposal of high-level radioactive waste and spent nuclear fuel. With respect to the Civilian Radioactive Waste R&D program, the purpose of this title is --

(1) to provide technology input to the Secretary of Energy relevant to the disposal of high-level radioactive waste and spent nuclear fuel, and

(2) to authorize the Secretary of Energy to provide for a focused and integrated high-level radioactive waste and spent nuclear fuel research and development program, including:

  (a) the development of licensing data through cooperative demonstrations of dry storage of spent nuclear fuel and rod consolidation (Section 218);

  (b) A program of research, development, and investigation of alternative means and technologies for the permanent disposal of high-level radioactive waste from civilian nuclear activities and Federal research and development activities (Section 222); and

  (c) A program for cooperation and technical assistance with NNWS in the fields of spent fuel storage and disposal (Section 223).

The Secretary is required to fund these activities from the Energy Supply Research and Development Appropriation rather than from revenues collected from utilites and deposited in either the Nuclear Waste Fund or the Interim Storage Fund. To accommodate the funding of these generic and alternative activities, the DOE has created a decision unit entitled Civilian Radioactive Waste Research and Development Program comprised of four subprograms: Spent Fuel Storage Development; Alternative Disposal Concepts;

Generic Methods and Supporting Studies; and Program Direction. No funds are being requested in FY 1987, however, for the Alternative Disposal Concepts Subprogram and the Generic Methods and Supporting Studies Subprogram. Accordingly, activities to implement Section 222 of the NWPA will not be pursued.

The Federal Interim Storage program is contingent upon utility need. The NRC establishes the eligibility criteria for this service under 10 CFR Parts 1 and 53. Currently, there is no expressed utility need for this service, and therefore, DOE is funding only planning activities relevant to Federal Interim Storage. These planning activities are included in the Spent Fuel Storage Reseach subprogram. However, funding of these activities will be transferred to the Interim Storage Fund upon its activation. The Civilian Radioactive Waste Research and Development program is managed by the Director, Office of Civilian Radioactive Waste Management who reports directly to the Secretary as mandated by Section 304(b) of the Act.

There are several varied objectives associated with the Civilian Radioactive Waste R&D Spent Fuel Storage Development Subprogram. It provides assistance to utilities for spent nuclear fuel storage development including the development of data and demonstrations to support dry storage of spent nuclear fuel and rod consolidation. It provides technical assistance to NNWS in the fields of spent nuclear fuel storage and disposal and it plans for Federal Interim Storage, if needed.

The FY 1987 Request is $6,500,000 which is $9,564,000 less than the amount appropriated in FY 1986, and the narrative justification that follows is focused on this level of funding.

	FY 1985 Appropriation	FY 1986 Appropriation	FY 1987 Request
A. Spent Fuel Storage Development - Total..........	$12,465	$ 8,554	$ 6,300
Operating expenses - Only....	$11,465	$ 7,496	$ 6,300

Implementation Strategy

The objectives of the Department's Spent Fuel Storage Development Subprogram are to encourage and expedite the most efficient use of existing storage facilities and the addition of new storage capacity in a timely fashion. The primary means for accomplishing this under the NWPA are:

(1) To establish, in cooperation with the private sector, a demonstration program for the dry storage of spent nuclear fuel at civilian nuclear power reactor sites with the objective of establishing one or more technologies that the Nuclear Regulatory Commission (NRC) may, by rule, approve for use by the industry, [Section 218(a)].

(2) To undertake a cooperative program with the private sector to encourage the development of spent fuel rod consolidation technologies in existing power reactor water storage basins, [Section 218(a)].

(3) To provide consultative and technical assistance on a cost sharing basis to the private sector for the design support and generic licensing documentation required by the Nuclear Regulatory Agency (NRA) to permit construction authorization and licensing for onsite dry storage technologies, [Section 218(a)].

(4) To establish a cost shared development program at Federal facilities for not more than 300MT of spent fuel to collect necessary data to assist the utilities involved in the licensing process, [Section 218(c)(1)].

(5) To provide generic research and development of alternative spent nuclear fuel storage technologies to enhance utility provided, at-reactor storage capabilities, [Section 218(b)(3)].

(6) To cooperate with non-nuclear weapon states by providing technical assistance in the field of spent fuel storage and disposal, [Section 223].

(7) To provide a full cost recovery program for the Federal Interim Storage (FIS) of not more than 1900 metric tons of storage capacity if requested by an owner or operator of a power reactor and upon a determination by the NRC that despite diligent pursuit of licensed alternatives, adequate storage capacity cannot be found and the continued orderly operation of the reactor plant is threatened, [Section 135 and 136].

Plans for further development of rod consolidation and dry storage through these means are summarized below.

(a) Spent Nuclear Fuel Rod Consolidation

Rod consolidation involves the dismantling of the fuel assembly and rearranging the spent fuel rods into a more compact array. It represents a cost-effective method for significantly increasing the capacity of storage pools that have sufficient structural strength to safely support the added weight and for reducing the number of shipments to disposal or storage facilities.

The Department began its research on rod consolidation in FY 1980 when it contracted for the design and fabrication of Pressurized Water Reactor rod consolidation equipment. In FY 1981, the Department successfully completed a cold demonstration of this equipment using a dummy assembly. This equipment was then modified to handle Boiling Water Reactor (BWR) spent fuel for use in a cooperative demonstration program with the TVA. This demonstration is to be completed in FY 1986, and involves the disassembly and consolidation of 12 BWR assemblies located in the Browns Ferry storage pool. A final report of this demonstration will be issued in FY 1987.

In May 1983, the Department issued a solicitation for cooperative agreement proposals for licensed in-basin rod consolidation. One proposal was received and negotiations are underway. Completion of negotiations and finalization of an agreement are expected in FY 1986. Activities will be initiated in FY 1986 and the actual schedule will depend on the negotiated scope of work. This new agreement will supplement the unlicensed BWR rod consolidation demonstration with the TVA and meet the objective of a licensed demonstration of an in-pool consolidated spent fuel storage in a time frame consistent with industry needs. An objective of this

In the first quarter of FY 86 an opportunity for an early demonstration of in-pool rod consolidation became available at the West Valley storage pool with fuel owned by Rochester Gas and Electric Company (RG&E) and consolidation equipment fabricated by the Nuclear Assurance Cooperation. This project is in process and expected to be completed by the end of FY 86. The consolidated fuel will be shipped back to the RG&E - Ginna facility for storage.

It is expected that, where physically possible, significant quantities of spent fuel will be consolidated and that this could result in a substantial increase in storage capacity at some reactor sites.

(b) Dry Storage

Dry storage systems provide an alternative for additional spent fuel storage at nuclear powerplants that cannot accommodate reracking or rod consolidation because of the economic, seismic, or structural limitations of their spent fuel storage pools. A variety of dry storage systems under consideration include casks, drywells, silos, and vaults; these systems are passive, modular, and cost-effective because they are easily maintained. The modular aspect offers the economic advantage of adding storage in small increments, thereby avoiding large initial capital outlays.

The Department has been actively supporting dry storage technologies. Drywell, silo, and vault storage have been demonstrated at the Department's facilities in Nevada. Dry storage of light water reactor spent fuel, however, has never been licensed in the United States. To address this, the Department entered into a interagency agreement with the TVA in 1982 to demonstrate the licensed storage of BWR spent fuel in two prototype dry storage casks. These casks were the REA-2023 and the CASTOR 1C. The REA cask was designed to store 52 BWR fuel assemblies and the CASTOR cask was designed to store 16 BWR fuel assemblies. The REA cask is owned by the Department and is now being considered for an alternate activity at a Federal Site due to its unlicensed status. A license application was submitted by TVA to NRC in FY 1984 for the CASTOR 1C cask. The cask will be loaded with fuel following NRC approval of the license application, which could be in FY 1986 or FY 1987. Fuel will be stored about 2 years at which time the fuel will be returned to the storage pool.

In addition, a solicitation for cooperative agreement proposals for dry storage demonstrations was issued in May 1983. Proposals were received and cooperative agreements negotiated with Virginia Power and the Carolina Power and Light Company. These agreements were signed in March 1984. The Virginia Power agreement provides for the licensed testing of spent fuel in five casks at the Surry Power Station. In addition, Surry fuel will be shipped to INEL for an unlicensed test in the four casks supplied by Virginia Power. The Federal site tests will demonstrate dry storage using different cover gases, including air, and may involve consolidation of some fuel. The program will be able to upgrade the Idaho Test Area North (ID-TAN) facility this year and receive the 4th shipping/storage cask under the cost-shared DOE/Virginia Power cooperative agreement. Also, the program would proceed with activities necessary for establishing the technical bases for NRC to license dry storage by generic rule. The Carolina Power and Light agreement provides for licensed testing of dry storage at the H.B. Robinson Plant Site utilizing horizontal, modular concrete silos. The fuel will be sealed in inerted canisters. These dry storage demonstrations will expand the technical data base available for

Carolina Power and Light agreement provides for licensed testing of dry storage at the H.B. Robinson Plant Site utilizing horizontal, modular concrete silos. The fuel will be sealed in inerted canisters. These dry storage demonstrations will expand the technical data base available for license applications of dry storage concepts, and will supplement data from other demonstrations such as the one being conducted with TVA.

The technical data for the 10 CFR 72 licensing provision at specific reactor sites, cask performance characteristics and cost-effectiveness of dry storage technology will be obtained from these demonstrations.

(c) Federal Interim Storage

The increased efficiency of onsite spent fuel storage that is expected to result from successful completion of the fuel rod consolidation and dry storage demonstrations discussed in the previous section should be sufficient to preclude the need for Federal Interim Storage. However, in compliance with the NWPA of 1982 and as a prudent backup in case unexpected problems arise during the rod consolidation and dry storage demonstrations, DOE has developed a deployment plan, as required by the Act, to provide Federal Interim Storage if any utility requests it and the NRC determines that the utility is eligible under 10 CFR 53. Federal Interim Storage planning will meet the legislated requirements for annual revision of Federal Interim Storage fee schedule and deployment plans considering changes that have occurred since FY 1986. DOE's ability to respond to requests for Federal Interim Storage in the time frame required will be enhanced by this updated planning.

	FY 1985 Appropriation	FY 1986 Appropriation	FY 1987 Request
Capital equipment - Only...........	$1,000	$1,058	---

No funds are being requested for FY 1987.

	FY 1985 Appropriation	FY 1986 Appropriation	FY 1987 Request
B. Program Direction..............	$ 266	$ 303	$ 200

At the Departmental Request, three (3) full-time equivalents and $200,000 are required to maintain management oversight of the Civilian Waste Research and Development programs in FY 1987. The personnel required include administrative and technical talent who manage a broad range of activities, including research, development, demonstration, industrial involvement, and international programs.

Headquarters staff are responsible for establishment of broad objectives, scopes of work, general program resource levels, and broad technical management interfaces necessary for program direction. Specific functions include assessment of technical progress project planning, milestone progress, cost expenditures, guidance, overview and integration of all contractor activities, and initiation of appropriate actions to resolve problems in any of these areas.

Also, Headquarters personnel handle active interfaces with other Executive Branch agencies such as the Department of State and, the Nuclear Regulatory Commission, and respond to numerous public and Congressional inquiries. Other interfaces are maintained with the nuclear industrial community and contractors, including the Electric Power Research Institute, the utility industry, major suppliers, and the National Laboratories.

A detailed breakout of the Program Direction request follows:

	FY 1985 Appropriation	FY 1986 Appropriation	FY 1987 Request
Personnel Compensation.............	$ 230	$ 256	$ 168
Personnel Benefits.................	27	28	20
Travel and Transportation of Persons......................	9	19	12
Total............................	$ 266	$ 303	$ 200

Nuclear Waste Fund

DEPARTMENT OF ENERGY

Proposed Appropriation Language

Nuclear Waste Disposal Fund

For nuclear waste disposal activities to carry out the purposes of Public Law 97-425, including the acquisition of real property or facility contruction or expansion, [$521,460,000] $769,349,000, to remain available until expended, to be derived from the Nuclear Waste Fund. To the extent that balances in the fund are not sufficient to cover amounts available for obligation in the account, the Secretary shall exercise his authority pursuant to section 302(e)(5) to issue obligations to the Secretary of the Treasury. (Public Law 99-141, making appropriations for energy and water development, 1986.)

DEPARTMENT OF ENERGY

FISCAL YEAR 1987 CONGRESSIONAL BUDGET REQUEST

SUMMARY OF ESTIMATES BY APPROPRIATION BY MAJOR ACTIVITY

NUCLEAR WASTE FUND

(Budget Authority in Thousands of Dollars)

	FY 1985 Actual	FY 1986 Estimate	FY 1987 Request
Nuclear Waste Fund	$ 327,669	$ 499,037	$ 769,349
Revenues	$-1,721,011	$-498,900	$-538,000

DEPARTMENT OF ENERGY
FY 1987 CONGRESSIONAL BUDGET REQUEST
PROGRAM OVERVIEW

Nuclear Waste Fund

This overview document describes the Nuclear Waste Fund program within the Department of Energy. The Nuclear Waste Fund Program includes activities in the following major areas: geologic repositories, monitored retrievable storage (MRS), transportation and systems integration, program management and technical support.

Pursuant to Section 8 of the Nuclear Waste Policy Act of 1982 (NWPA) the President, on April 30, 1985, concluded that a defense only repository is not required. The President directed the Department to proceed with plans for collocation of commercial high-level radioactive waste and high-level radioactive waste resulting from energy defense activities.

The FY 1987 budget represents the third budget formulated by the Office of Civilian Radioactive Waste Management since the passage of the Nuclear Waste Policy Act (NWPA) of 1982. This budget presents an integrated picture of all programmatic activities listed above.

Objectives and strategies are discussed below:

Program Objectives

1. To site, design, license, construct, operate and decommission geologic repositories for the safe, environmentally acceptable disposal of radioactive waste, including high-level radioactive waste resulting from atomic energy defense activities.

2. To complete a detailed study of the need for and feasibility of, and submit to Congress a proposal for, the construction of one or more MRS facilities.

3. To ensure acceptance of waste for disposal by January 31, 1998, in accordance with the annual capacity report as stipulated in the Department's disposal contracts with the nuclear utilities and in conformance with the NWPA of 1982.

4. To ensure fiduciary responsibility in the execution and management of technically sound, cost-effective programs.

5. To develop and operate a safe, efficient system to transport spent fuel and high-level waste from the sources at the reactors to a repository.

The Department plans to carry out this program with full adherence to the legislated institutional process while developing sound technical data needed to support key milestones and decision points.

Program Strategy

As an early step in carrying out the Department's plan for the development and operation of geologic repositories for the permanent disposal of spent nuclear fuel and high-level radioactive waste, the Department has executed contracts with the owners and generators of civilian nuclear wastes. These contracts specify the terms under which the Department will accept the wastes via the annual capacity report which will project the annual receiving capacity for DOE facilities. Currently, the acceptance rate is based on the emplacement capacity projected for two planned geologic repositories which will be operated and maintained by the Department, although construction of the second repository is contingent upon future Congressional authorization.

This Nuclear Waste Fund budget prices out the work efforts for the programs for FY 1987 and provides an estimate of FY 1988 and FY 1989 requirements. For the repository activity, the site characterization phase of the program is dominant in this time frame. Site characterization activities include obtaining the technical information necessary to support a licensing application through field exploration from each of the sites. This activity will include the sinking of exploratory shafts to the depth of the proposed disposal locations, extensive surface and subsurface investigations, and other development and evaluation techniques required to obtain the data needed to support a license application to NRC. In this process, the Department will satisfy the Federal/State agreements that are in effect relating to the site of a repository. Funds are also being requested in this submittal for FY 1987 thru FY 1989 to support the activities separately proposed to Congress in the MRS proposal.

Approved and Improved System Costs

Each year the Department analyzes the total system costs for a series of cases that reflect, as closely as possible, current program strategy for meeting legislative milestones and the most recent design studies. The January 1986 Total Systems Life Cycle Cost Analysis (TSLCC) estimates the costs for two alternative waste acceptance configurations; the approved system (AS) which is based on current strategy, and the improved performance system (IPS) configuration which is based on the integration of a Monitored Retrievable Storage Facility (MRS) into the system. A proposal to adopt this latter concept will be submitted to the Congress in early 1986. Preliminary 1986 cost estimates for ten reference cases of the AS system, where each reference case represents a different pair of geological media currently being considered for repository location, range from $24 billion to $32 billion. The coresponding preliminary estimates for the reference cases of the IPS system range from $26 billion to $34 billion.

The TSLCC analysis divides the AS system costs into 3 major categories. These are: development and evaluation costs, repository construction and operation costs, and spent fuel transportation costs. The IPS total systems costs adds a forth category which addresses the MRS facility. The MRS facility costs are projected to be approximately $2.8 billion. However, the incremental difference between AS and IPS system costs for identical reference cases is only approximately $2 billion. Total cost differences between the AS and IPS systems are less than the explicit MRS facility costs because some of the functions previously performed at the repositories have been transferred to the MRS.

Nuclear Waste Policy

The NWPA was enacted by Congress in December 1982 and signed into law by President Reagan on January 7, 1983. As stated earlier, the NWPA establishes a comprehensive national policy on high-level waste; it establishes:

1. Specific and comprehensive goals and objectives which are . . .
    - o to site, design, license, construct, and operate geologic repositories for permanent disposal,
    - o to contract with utilities for accepting their waste, and
    - o to develop a proposal for construction of one or more MRS facilities for temporary waste storage;

2. Credible institutional mechanisms, including . . .

   - approval of a mission plan,
   - assured funding through a utility fee based on net generation of electricity, and
   - creation of a waste management organization in DOE reporting to the Secretary; and

3. Measures to address public concerns, including . . .

   - sound, credible technical programs to address and resolve technical issues concerning permanent geologic disposal,
   - provision and funding for public participation,
   - a regulatory process suitable for a first-of-a-kind undertaking,
   - state/tribal participation in siting decisions, with rights to submit a notice of disapproval to the Congress over the selection of a site within State or tribal lands,
   - entitlement to compensation for negative impacts resulting from a waste disposal project.

Repository Program

The NWPA mandates a comprehensive set of Federal activities designed to have the Nation's first permanent nuclear repository in operation by 1998.

Interwoven throughout the program is a fabric of checks and balances that ensure Federal accountability to the States, to the public, to the utilities and rate payers, and to affected Indian Tribes--as well as to the Congress. These institutional requirements set forth a framework for developing one or more permanent repositories and to ensure that a safe, efficient and timely waste management system is developed and implemented. It is incumbent on DOE, therefore, to perform a technically sound job of site selection, repository and MRS construction, transportation and disposal of spent fuel and/or high-level waste.

Further, DOE intends to conduct an open and accountable decision-making process throughout the life of the program. This process includes pursuing thoughtful working relationships among individuals and institutions. The cornerstone of such an approach must be communication, that is, consistent and timely sharing of information and perspective. These major principles define DOE's long-term approach; short-term decisions will not be allowed to undercut this strategy.

In the FY 1986 program for the first repository, DOE will nominate five and recommend three sites for site characterization for the President's final decision. DOE's nomination and recommendation of sites will be based on the siting guidelines (10 CFR 960), utilizing available geotechnical, environmental and other relevant information. After the recommendation is final, DOE will begin an intensive site evaluation program including in situ testing at the bottom of deep exploratory shafts. Shaft construction at the three sites will take approximately 2 years with in situ tests scheduled to start in FY 1989. Currently, DOE is planning two shafts at each site. After site characterization has been completed, DOE will recommend one site to the President for the Nation's first repository site. Once approved, DOE will submit its license application to the Nuclear Regulatory Commission (NRC).

The NWPA also directs DOE to conduct site investigations for a second repository, although construction of the second repository is contingent upon future Congressional authorization. The process for selecting the second repository site is the same winnowing process as described above for the first repository with decision points spaced about 7 years after those for the first repository. The DOE may consider sites identified as potentially acceptable but not nominated for the first repository, sites found potentially acceptable from rock formations not previously studied in the first repository selection process and sites characterized but not chosen for the first repository site. The final Area Recommendation Report identifying the crystalline rock areas to be investigated further will be issued in FY 1987.

Monitored Retrievable Storage

The NWPA directs the DOE to complete a study of the need for and feasibility of an MRS, and submit to the Congress a proposal for the construction of one or more MRS facilities. The NWPA specifies that the proposal include a program for siting, development, construction and operation of an MRS facility; site specific designs and cost estimates for the construction of the first facility; a plan for funding the construction and operation of such facilities; and a plan for integrating such facilities into the Federal waste management system. The proposal will be submitted to Congress in February 1986. Funds are being requested in this submittal for FY 1987 thru FY 1989 to support the activities in the proposal.

Transportation and Systems Integration

The systems integration activities focus on integrating, coordinating, and optimizing the total waste management system in a cost-effective manner.

The transportation objective is to assure that a safe, environmentally acceptable, and cost-effective transportation system is in place by 1996. This system must utilize the private sector to the fullest extent possible. Activities will continue in FY 1987 to support private sector design and development of cost-effective transportation equipment and components needed to safely transport commercial spent fuel from the civilian reactors to the repository or MRS.

Legislated Milestones

Listed below are important milestones which are required by the Act and revisions presented in the Mission Plan.

- By July 7, 1983, DOE is to issue general guidelines for the "recommendation of sites for repositories." Congress was previously notified that this milestone was not achieved. These guidelines were approved by NRC in June 1984 and were published in the Federal Register in December 1984.

- By January 7, 1984, DOE is to submit to the Congress a location report on a Test and Evaluation Facility (TEF). DOE has decided that, if needed, a TEF would be collocated at a potential repository site and has notified Congress (in April 1984) that the decision on whether or not to propose a TEF would be made in FY 1987.

- By April 7, 1984, DOE is to submit a comprehensive Mission Plan which shall provide an information base sufficient to permit informed decisions to be made in carrying out the repository and R&D programs contained in the Act. The final Mission Plan was issued and submitted to Congress in July 1985.

- By January 1, 1985, DOE is to complete nomination of at least five sites and recommend three repository sites to the President for site characterization. This milestone has been rescheduled to 1986.
- By June 1, 1985, DOE is to submit to the Congress a proposal for the construction of one or more MRS facilities. On May 31, 1985, Congress was provided with a status report that informed the appropriate Committees of the progress made to date in preparation of the proposal, and described the plans and schedules for its completion. The proposal package is currently scheduled to be submitted to the Congress in February 1986.
- By March 31, 1987, following the completion of site characterization, the President is to submit to the Congress his final selection of the site for the first repository. (This deadline may be extended to 12 months, and the Governor, legislature, or Indian tribe--if the site is on a reservation--may disapprove the siting decision, subject to override by Congressional Joint Resolution.) This is now scheduled for 1991.
- By January 1, 1989, or within 3 years of DOE application (whichever is later), the NRC is to decide whether to permit construction of the first repository. This milestone can be extended for up to 1 year. Current schedule for this is 1993.
- By July 1, 1989, DOE is to nominate five sites (including at least three not previously nominated) for a second repository and recommend three of these to the President. This is now scheduled for 1993.
- By March 31, 1990, the President is to submit to the Congress the final selection of the site for the second repository. This milestone can be extended for up to 1 year. Current schedule for this is 1999.
- By January 1, 1992, or within 3 years of DOE application (whichever is later), the NRC is to decide whether to permit construction of the second repository. This milestone can be extended up to 1 year. This is scheduled for 2002.
- By January 31, 1998, DOE is to begin accepting spent fuel and high-level waste for disposal in the first repository.

Program Highlights

Throughout the program there are numerous additional milestones and objectives, many of which relate to the rights of governors, legislatures, and any affected Indian Tribes, together with associated DOE responsibilities. Some of the near-term major accomplishments and planned activities of the Nuclear Waste Fund program are summarized below:

FY 1985 accomplishments include:

- Published Mission Plan.
- Issued siting guidelines.
- Published 3rd Fee Adequacy Report.
- Issued draft Project Decision Schedule.
- Issued draft Environmental Assessments.
- Held public hearings on draft Environmental Assessments.

- Issued regional to area screening methodology for crystalline rock program.
- Issued final Regional Characterization Reports for the crystalline rock program.
- Received payments totaling $1,427,428,803 -- more than half of the one-time fee liability for civilian nuclear waste in existence as of April 6, 1983.
- Published Second Annual Report to Congress.
- Initiated studies of preliminary concepts and techniques for integrating the overall waste management plan.
- Initiated independent financial audit of Nuclear Waste Fund for FY 1985.
- Submitted report to Congress on alternative means of financing and managing radioactive waste facilities.
- Identified candidate sites and completed facility designs for the MRS.
- Issued the Draft Transportation Business Plan for public comment
- Developed Draft Transportation Institutional Plan for public comment.
- Completed an independent financial audit of the Nuclear Waste Fund for FY 1983 and FY 1984.
- Reimbursed U. S. Treasury $264,964,663 the total amount owed on the appropriated debt transferred to the NWF upon enactment of the NWPA in FY 1983.

Expected FY 1986 accomplishments include:

- Issue final Environmental Assessments for first repository.
- Recommend three candidate first repository sites to the President for site characterization.
- Initiate advanced conceptual designs for the waste package and repository at the three selected candidate sites.
- Issue draft Area Recommendation Report for crystalline rock investigations.
- Finalize agreement with DOE defense programs on fee payments for defense waste disposal.
- Stimulate private sector efforts to design and certify advanced transportation casks.
- Complete independent financial audit of Nuclear Waste Fund for FY 1985.
- Begin incorporating changes into the storage, transportation and repository design activities as a result of system integration studies initiated in FY 1985.
- Submit a proposal to Congress for the construction of one or more MRS facilities.
- Initiate independent financial audit of the Nuclear Waste Fund for FY 1986.

- Publish Third Annual Report to Congress.
- Publish Fourth Fee Adequacy Report.
- Issue the Project Decision Schedule.

Expected FY 1987 accomplishments include:

- Issue Site Characterization Plans for three candidate first repository sites.
- Start construction of exploratory shafts in basalt and tuff, if selected.
- Issue final Area Recommendation Report for crystalline rock investigations.
- Issue draft Area Characterization Plan for crystalline rock investigations.
- Initiate development of a generic repository conceptual design in crystalline rock.
- Publish Fourth Annual Report to Congress.
- Publish 5th Fee Adequacy Report.
- Complete independent financial audit of Nuclear Waste Fund for FY 1986.
- Initiate independent financial audit of Nuclear Waste Fund for FY 1987.
- Continue engineering development, fabrication and testing of prototypes of "new generation" casks for truck, rail and barge transport.
- Complete evaluation of waste characteristics, packaging and handling capabilities at individual reactors.

DEPARTMENT OF ENERGY
FY 1987 CONGRESSIONAL BUDGET REQUEST
LEAD TABLE
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT
NUCLEAR WASTE FUND
(Tabular dollars in thousands. Narrative material in whole dollars.)

Nuclear Waste Fund	FY 1985 Appropriation	FY 1986 Appropriation	FY 1987 Base	FY 1987 Request	Request vs Base	FY 1988 Estimate	FY 1989 Estimate
First Repository							
Operating expenses....	$227,336	$373,350	$373,350	$524,000	+$150,650	$558,600	$470,800
Capital purchase......	7,910	12,700	12,700	17,800	+5,100	5,100	3,600
Construction..........	---	---	---	---	---	68,700	97,100
Total.................	235,246(a)	386,050	386,050	541,800	+155,750	632,400	571,500
Second Repository							
Operating expenses....	24,609	34,600	34,600	72,500	+37,900	69,800	67,900
Capital purchase......	100	900	900	6,200	+5,300	4,400	3,600
Construction..........	---	---	---	---	---	---	---
Total...............	24,709	35,500	35,500	78,700	+43,200	74,200	71,500
Monitored Retrievable Storage (MRS)							
Operating expenses....	17,469	3,000	3,000	38,800	+35,800	27,400	23,200
Capital purchase......	---	---	---	---	---	---	---
Construction..........	---	---	---	7,200	+7,200	22,600	29,800
Total...............	17,469(a)	3,000	3,000	46,000	+43,000	50,000	53,000
Transportation and Systems Integration							
Operating expenses....	2,875	21,275	21,275	32,875	+11,600	32,800	27,050
Capital purchase......	---	---	---	500	+ 500	1,000	4,000
Construction..........	---	---	---	---	---	---	---
Total...............	2,875	21,275	21,275	33,375	+12,100	33,800	31,050
Program Management and Technical Support							
Operating expenses....	43,305	52,712	53,260	68,595	+15,335	71,622	71,650
Capital purchase......	765	500	500	879	+ 379	1,042	542
Construction..........	---	---	---	---	---	---	---
Total...............	44,070(a)	53,212	53,760	69,474	+15,714	72,664	72,192
Debt Service (Interest)	3,300	---	---	---	---	---	---
Total							
Operating expenses....	318,894	484,937	485,485	736,770	+251,285	760,222	660,600
Capital purchase......	8,775	14,100	14,100	25,379	+11,279	11,542	11,742
Construction..........	---	---	---	7,200	+7,200	91,300	126,900
Nuclear Waste Fund................	$327,669	$499,037(b)	$499,585(b)	$769,349	$+269,764	$863,064	$799,242

Authorization: Sec. 31, P.L. 83-703, P.L. 97-425

(a) During FY 1985, $8,994,000 was reprogrammed from the First Repository and Program Management and Technical Support to the Monitored Retrievable Storage Program.

(b) Reflects reduction of $22,423,000 in compliance with the Gramm-Rudman-Hollings deficit reduction act, P.L. 99-177. Details of the reductions are provided in the attached table.

DEPARTMENT OF ENERGY

FY 1987 CONGRESSIONAL BUDGET REQUEST

Adjustments to FY 1986 Appropriations
(dollars in thousands)

	FY 1986 Appropriation	Gramm-Rudman-Hollings	General Reduction	Management Initiatives	DOE Wide FTE Reduction	Pay Restoration	Subtotal	Comparability Adjustments	Total
Nuclear Waste Fund									
First Repository									
Operating expenses...........	$386,100	$-12,750	---	---	---	---	---	---	$373,350
Capital purchase............	12,700	---	---	---	---	---	---	---	12,700
Construction................	---	---	---	---	---	---	---	---	---
Total......................	398,800	-12,750	---	---	---	---	---	---	386,050
Second Repository									
Operating expenses...........	40,900	- 6,300	---	---	---	---	---	---	34,600
Capital purchase............	900	---	---	---	---	---	---	---	900
Total......................	41,800	- 6,300	---	---	---	---	---	---	35,500
Monitored Retrievable Storage (MRS)									
Operating expenses...........	3,000	0	---	---	---	---	---	---	3,000
Capital purchase............	---	---	---	---	---	---	---	---	---
Construction................	---	---	---	---	---	---	---	---	---
Total......................	3,000	0	---	---	---	---	---	---	3,000
Transportation and Systems Integration									
Operating expenses..........	22,625	- 1,350	---	---	---	---	---	---	21,275
Capital purchase............	---	---	---	---	---	---	---	---	---
Construction................	---	---	---	---	---	---	---	---	---
Total.....................	22,625	- 1,350	---	---	---	---	---	---	21,275
Program Management and Technical Support									
Operating expenses.........	54,735	- 2,023	---	---	---	---	---	---	52,712
Capital purchase...........	500	---	---	---	---	---	---	---	500
Construction...............	---	---	---	---	---	---	---	---	---
Total.....................	55,235	- 2,023	---	---	---	---	---	---	53,212
Subtotal Nuclear Waste Fund.............	521,460	-22,423	---	---	---	---	---	---	499,037
Debt Service (Interest)									
Projected Receipts									
One mil/kwh fee.............	378,600	---	---	---	---	---	---	---	378,600
One-Time fee................	2,300	---	---	---	---	---	---	---	2,300
Total.....................	$380,900	---	---	---	---	---	---	---	$380,900
Interest Income...............	$118,000	---	---	---	---	---	---	---	$118,000

	FY 1985 Appropriation	FY 1986 Appropriation	FY 1987 Base	FY 1987 Request	Request vs Base	FY 1988 Estimate	FY 1989 Estimate
Staffing Total FTE.	238	292	292	292	---	292	292

Projected Receipts by Fiscal Year
(dollars in thousands)

Description	1985[1]	1986	1987	1988	1989
One mil/KWh fee...........	$ 367,327	$378,600(2)	$420,500(2)	$474,500(2)	$508,600(2)
One-time fee..............	1,427,429	2,300	2,500	17,200	17,500
Total..................	$1,794,756	$380,900	$423,000	491,700	$526,100
Interest Earned	$ 38,455	$118,000(3)	$115,000(3)	$105,000(3)	$ 99,000(3)

(1) 1985 reflects actual cash collected.

(2) Based on projected gross nuclear electricity generation reduced by 5% to approximate net nuclear electricity generation as a result of the recent Wisconsin court decision. (Wisconsin Electric Power Company, et al vs Hodel, 83-1066,84-8571 (decided December 6, 1985)). At the time of this budget submission, net nuclear electricity generation projections are expected by the end of January.

(3) Based on average yield of Treasury security portfolio.

DEPARTMENT OF ENERGY
FY 1987 CONGRESSIONAL BUDGET REQUEST
SUMMARY OF CHANGES
NUCLEAR WASTE FUND
(dollars in thousands)

FY 1986 Appropriation Enacted $499,037

Built-in increases and decreases:
Federal Telecommunications Systems, commercial telephone, Standard Level User Charges .... +548

FY 1987 base $499,585

Program increases and decreases:

First Repository .... +155,750

- The increased funding will provide for continuation of intensive site characterization activities that were initiated in FY 1986. At the three sites, increased borehole drilling and geologic analyses will provide surface and subsurface based data to help determine site suitability as well as provide information needed to assist in developing waste package and repository designs. Construction of exploratory shafts will begin at the tuff and basalt sites. In addition, the increase will also provide for the accelerated repository design and equipment development, licensing, and quality assurance activities.

Second Repository .... +43,200

- The increase will support the preparation for area phase field studies, the expansion in the domestic and international cooperative programs, grants to affected States and Indian Tribes, and engineering activities related to waste package and repository design.

Monitored Retrievable Storage .... +43,000

- The increase will support the activities in the MRS proposal that will be submitted to Congress in February 1986.

Transportation and Systems Integration .... +12,100

- Transportation cask development contracts will be executed which will increase the transportation institutional outreach activities. An increase in economic and environmental analysis is required to provide route specific EIS information. Continue development of technology and data systems. Increase program management requirements (+$9,250).

- Under Systems Integration, increases are required primarily for prototype development and testing in the area of waste handling and packaging. Accelerated waste management systems integration activities are supported to assure that the various parts of that system are integrated into an efficient and cost-effective system (+$2,850).

SUMMARY OF CHANGES
NUCLEAR WASTE FUND
(Continued)

Program Management and Technical Support..................................	+15,714

- Technical support increases are primarily for contract support to continue integration and coordination activities, defense waste studies, outreach, financial assistance, waste package design, siting analysis/assessment, performance modeling/assessment, and initiate development of The Environmental Impact Statement and environmental analysis studies (+$15,593).

- Program management increase is due primarily to other administrative support costs above the base (+$121).

FY 1987 Congressional Budget..	$769,349

DEPARTMENT OF ENERGY
FY 1987 CONGRESSIONAL BUDGET REQUEST
NUCLEAR WASTE FUND
(Budget Authority in Thousands)

	FY 1986 Appropriation	FY 1987 Request	FY 1988 Estimate	FY 1989 Estimate
Nuclear Waste Fund - Grand Total	$521,460	$769,349	$863,064	$799,242

The goal of the Nuclear Waste Fund program is to permanently isolate defense and civilian high-level radioactive waste and spent fuel by placing them in a geologic repository. To this goal, the Department is relying primarily on deployment of one or more permanent repositories and possibly storage facilities such as the Monitored Retrievable Storage.

The objective of the Geologic Repositories Program is to site, design, license, construct, and operate and decommission one or more permanent repositories. The program's schedule is directed towards operating the first repository in 1998 by following the institutional process established by Congress in the Nuclear Waste Policy Act of 1982 (NWPA). This process includes State, Indian Tribe, and public involvement in site characterization activities leading to DOE site recommendation, Presidential site recommendation, and acceptance of the recommendation by the affected state, by any affected Indian Tribe(s), and by Congress. If the program needs additional research on repository operational activities, equipment development and demonstration or waste handling and emplacement processes, Congress has authorized the construction of a Test and Evaluation Facility as part of the repository program.

The Department will prepare and submit a proposal to Congress in February, 1986, for the construction of a Monitored Retrievable Storage facility. MRS program funding for 1987 thru 1989 contained in this budget supports that proposal.

The Transportation and System Integration activities are critical components of the overall waste management program. The transportation objective is to assure that a safe, environmentally acceptable, and cost-effective transportation system is in place by 1996. This system will utilize the private sector to the fullest extent possible. System integration activities will focus on integrating, coordinating, and optimizing the total waste management system and all of its components, including evaluation of alternative concepts, in a cost-effective manner.

The Office of Civilian Radioactive Waste Management (OCRWM), which was specifically authorized by Congress, manages these programs and is responsible for coordinating other activities that support these efforts. The salaries of the Federal personnel who manage these major programs and the support activities are also part of the Fund's budget request. They are included because Congress directed the Department to carry out these program activities on a full cost recovery basis.

This document provides a background on the Fund's revenue sources, defines the repository activities, and then separately describes the budget request for the major programs and their supporting activities. As mandated by the Act, the Fund's budget request is specifically submitted to support the FY 1987 appropriations. However, Congress also directed that the Department submit a triennial budget for authorization purposes. Therefore, the budget request is presented for each fiscal year, that is, FY 1987, FY 1988 and FY 1989.

Revenue Sources

To finance these programs, the NWPA established the Nuclear Waste Fund in the Treasury of the United States. The Fund receives all of the revenue the Department collects from generators of civilian high-level nuclear waste. In addition, the Fund receives revenues from the Department of Energy for the disposal of nuclear wastes from the Department's defense programs. Through the appropriation process, Congress makes funds available to the Department to carry out programs. Obligations incurred under this authority are liquidated from cash balances in the Fund. To the extent balances in the Fund are insufficient to cover maturing obligations, DOE can borrow cash from Treasury. Conversely, any excess cash balances over program requirements may be invested in Treasury obligations.

Currently, the main sources of revenue for the Fund are the fees Congress imposed on electricity generated by civilian nuclear power reactors. High-level radioactive waste and spent fuel generated prior to April 7, 1983 is subject to a one-time fee that is equivalent to one mill/kWh. Civilian nuclear power generation after April 6, 1983 is subject to an ongoing fee of one mill/kWh. As of the end of June, 1985 the total liability for one-time fees was approximately $2,300,000,000. At that time, a total of 32 entities consisting of public utilities, companies and the DOE nuclear energy program made one-time fee payments totaling $1,425,923,598. DOE paid $5,293,018 in one-time fees for non-defense waste, which is included in this total. The remaining 14 civilian nuclear power companies elected to make a series of time payments that begin at a later date. Three (3) power companies chose the "40 quarter option" (FY 1985 payments $1,508,779) and eleven (11) chose to pay under the "one-lump sum plus interest prior to the first delivery of spent fuel" option. All one-time fee payments made after June 30, 1985 are subject to and will include accrued interest from April 7, 1983.

The NWPA required the Department to evaluate the use of disposal capacity at one or more repositories for the disposal of high-level radioactive waste resulting from atomic energy defense activities. The Department recommended, and the President agreed on April 30, 1985, to dispose of defense waste in a civilian repository. The Federal Government will pay a fee equivalent to that paid by the public utilities for disposal of the waste in the repository. This use of the repository will generate additional revenues for the Fund. The precise amounts of these fees have not been finally determined and, therefore, are not included in these revenue estimates.

Repository Activities

A general description follows for activities conducted within the geologic repositories program. The activities are commonly described in terms of a program work breakdown structure or WBS: systems, waste package, siting, repository development, exploratory shaft development and in situ testing, regulatory and institutional activities, test facilities, land acquisition, and project management.

Work in systems involves the development, verification, and application of performance assessment models to describe overall repository performance. These studies will demonstrate compliance with Nuclear Regulatory Commission (NRC) regulations for geologic disposal of nuclear wastes (10 CFR 60) and Environmental Protection Agency (EPA) standards for allowable releases to the accessible environment (40 CFR 191). Also included in systems is the management integration and optimization of data collected from the site, repository, and waste package subsystems.

Waste package activities are directed at developing a component of a multi-barrier engineered system, which will contribute to the technical conservatism inherent in the natural geohydrologic system. Designs of waste packages must be tailored to be compatible with the expected repository conditions in the potential host rocks to meet regulatory requirements for long-lived waste packages (300-1,000 years) and must be cost-effective. Important activities in this area include:

- materials screening and testing of waste form, canister, and backfill materials, and study of the near-field repository environment.

- design analysis, testing, and qualification of complete engineering-scale packages.

The major technical activities associated with siting are literature surveys and field mapping; drilling of test holes; analyses of geotechnical data including laboratory analyses of drill-core and water samples; surface and borehole geophysical surveys; seismic surveys; environmental analyses; and studies of socioeconomic impacts that may affect the area around the site. The geologic repositories program is focused on the main geohydrologic areas for the first repository: the basalt flows underlying the Hanford Site in Washington, a block of welded tuff underlying Yucca Mountain at the Nevada Test Site, salt domes in the Gulf Coast States of Louisiana and Mississippi, and bedded salt formations in Texas and Utah. Screening of additional sites in other potential host rocks, such as the crystalline rocks of the Northeastern, Southeastern, and North Central regions and other media will be considered for the second repository. Data for sites which are characterized but not selected for the first repository will be fully documented and maintained so these sites may be considered again for the second repository.

Repository activities involve the design of surface and subsurface facilities and of equipment and instruments necessary to operate, test, and decommission the repository. Emphasis is being placed on the following activities:

- laboratory and field experiments to provide information in support of repository design and performance modeling. This data base will be derived from characterization of geologic samples with respect to thermal and rock-mechanics properties.

- repository design, engineering studies, and cost estimating, including studies on waste emplacement configurations, gross thermal loading, underground layouts, and sealing/backfilling. These studies support development of an in situ test plan, equipment development plan, repository design needed for the license application and eventually final design, which will be used for actual repository construction.

Exploratory shaft development activities include long-lead procurement of liners and other critical materials, site preparation work, and design and construction of two shafts at each of the three sites in repository horizons to conduct in situ site investigations into the host rock. Exploratory shaft development and in situ testing at the base of the shafts will assist in the assessment of the technical suitability of a site and will help anticipate the difficulties that may arise during design and construction of the repository.

Regulatory and institutional activities involve coordination directly with the NRC and EPA in developing and following a repository licensing plan. Other activities in this area include developing, publishing, and updating plans for characterization of sites, and preparing environmental assessments and eventually an environmental impact statement for the selected repository site. The Department conducts all phases of the program, including site characterization efforts, in consultation and cooperation with affected States, Indian Tribes, and the public. In addition, cooperative efforts with other

Federal agencies, public information, and other outreach programs are carried out. As stated earlier, the Act broadens State and local government involvement in site selection and licensing proceedings. Specifically, the Department can provide financial and technical assistance to State and Indian Tribes to: review potential economic, social, public health, safety, and environmental impacts associated with the repository's deployment; engage in appropriate monitoring, testing, or evaluation activities; provide information to residents; and request required information and make comments and recommendations. Grants equal to taxes, as required by the NWPA, to States hosting exploratory shaft development and site characterization are also provided in this category.

Under test facilities, the Department operates facilities specially designed to conduct tests to better understand the behavior of materials, waste and rock when exposed to potential or actual repository conditions, and to develop equipment and instrumentation for the repository. Cooperative international technical programs are also conducted under this WBS element.

The Department's land acquisition activities help determine the legal requirements for acquiring land for a repository. Leases and permits must be obtained for site evaluation studies on private property. Where the Department is considering sites on land managed by the Bureau of Land Management (BLM), appropriate steps must be taken in coordination with the BLM to document program requirements and plans for acquisition under the Federal Land Policy and Management Act of 1976 (FLPMA).

The project management category provides for contractual assistance and quality assurance efforts in integrating and managing the varied activities and disciplines that compose the program.

As stated earlier, the previous two pages explained the general aspects of the geologic repositories program. The following pages describe these elements in much more detail, as well as other aspects of the program as noted below.

MRS

The Department will prepare and submit a proposal to Congress in February 1986, for the construction of a Monitored Retrievable Storage (MRS) facility. The MRS is proposed to be an integral part of the federal waste management system. Its primary function will be receive spent fuel rods from commercial nuclear power plants, consolidate them, package them in sealed canisters and ship them to the repository for disposal. It will also provide temporary storage for up to 15,000 MTU of spent fuel if required. It will receive, consolidate, and package between 2,500 and 3,000 MTU of spent fuel annually. The facility will be fully licensed by the Nuclear Regulatory Commission. MRS program funding for 1987 through 1989 contained in this budget supports this proposed facility.

Transportation

The NWPA requires DOE to develop and operate a safe and efficient system to transport spent fuel and high level waste from the reactors to a repository, or to an MRS and then to a repository. The system must: have the required hardware, use traffic management procedures agreeable to all parties involved and utilize by contract private industry to the fullest extent possible. Activities within this program are currently categorized into four major tasks: transportation systems acquisition; institutional programs; environmental and economic analyses; and technology development and testing support. Recognizing that an operating transportation system is dependent on successful completion of activities in each of these groups, early emphasis is being place on activities that will require the greatest lead time to accomplish.

Systems Integration

The objective of the systems integration effort is to ensure that the possible components of a waste system, i.e., mined geolgic repositories, waste generators, near term storage, transportation and a possible MRS facility, are integrated into an efficient, safe and on-time waste management system. To achieve this objective, the systems integration effort will: identify and baseline the requirements of the total system and maintain a current description of the waste management system that meets those requirements, including the system components, functions, and critical interfaces; enhance communication among the parties responsible for various systems components and functions in order to ensure compatibility and the coordination of interfaces; develop and maintain the capability to fully assess alternative systems concepts and to determine how a change in one part of the system will affect the rest of the system; conduct well-planned and well-coordinated systems studies and recommend to the OCRWM Director improvements to the design of the waste management system, as appropriate; and, support the development and testing of equipment or processes that have the potential to improve the waste management system.

This budget request for the NWF is subdivided into six major areas: (A) First Repository, (B) Second Repository, (C) Monitored Retrievable Storage (MRS), (D) Transportation and Systems Integration, (E) Program Management and Technical Support, and (F) Debt Service.

	FY 1986 Appropri-ation	FY 1987 Request	FY 1988 Estimate	FY 1989 Estimate
A. First Repository - Total	$386,050	$541,800	$632,400	$571,500

The objective of this program is to carry out the activities necessary to site, design, license, construct, operate, and decommission the first repository. The FY 1987 activities are presented by the specific program work breakdown structure previously discussed. The first repository program is conducted by three project offices and contractor organizations, with each organization concentrating its efforts on a potential host rock. Nine potentially acceptable sites have been identified that include two salt domes in Mississippi and one salt dome in Louisiana, and two bedded salt sites each in Utah and Texas being studied under the Salt Repository Project; a site in welded tuff at the Nevada Test Site conducted under the Nevada Nuclear Waste Storage Investigations Project; and a site in basalt at the Hanford site under the Basalt Waste Isolation Project.

The major programmatic milestones associated with the schedule for the first repository are as follows:

Milestones	Calendar Year	
o Nominate at least five sites and recommend three candidate sites to President for characterization........	April	1986
o Issue Site Characterization Plans (SCP) for basalt and tuff candidate sites....................................	December	1986
o Begin construction of first exploratory shaft............	May	1987
o Issue Site Characterization Plan for salt................	May	1987
o Start License Application design for repository..........	October	1988
o Complete performance assessments in support of Environmental Impact Statement (EIS).....................		1990
o Issue Final Environmental Impact Statement (FEIS)........		1991
o Recommend first repository site to Congress..............		1991
o Submit license application to NRC........................		1991
o Licensing completed......................................		1993-1994
o Begin operation..		1998

A. First Repository - continued

FY 1987 Congressional Budget Request................................ $541,800

The increased FY 1987 funding relative to FY 1986 for the first repository is mainly required for extensive site characterization, initiation of exploratory shaft construction, and intensive engineering tests and analyses to support waste package and repository designs.

1. Systems.. $ 22,700

Operation of a data base management system and conduct of systems engineering analyses for each project will continue. Data entry into the technical data base will accelerate as site characterization activities progress. Project integration support will continue to ensure that data acquisition, analysis and documentation are focused on issue resolution for meeting site characterization goals prior to license application. The performance assessments of the overall disposal system will continue to consider changes in the repository and waste package designs and to analyze disruptive events and their consequences. The updated analyses will also incorporate the additional laboratory and field data compiled in FY 1986 and FY 1987. Efforts on computer code benchmarking, validation, documentation, and verification will also continue.

2. Waste Package.. $ 41,100

Waste package design and development will continue at each of the three candidate sites. Advanced conceptual design for the waste packages for all sites will be underway and prototype testing will be conducted. Data from the systems integration studies in waste packaging and handling will be incorporated into the package design as appropriate.

In basalt, the corrosion and mechanical properties testing of the candidate container materials (two steels, copper, and 90-10 cupronickel) will result in a recommendation for reference and backup materials. Qualification tests will be initiated with small-scale heated model tests for packing saturation and container corrosion. Additional waste forms will be characterized and tested including high burn-up spent fuel and West Valley waste forms. Waste package environment analysis and waste package performance, reliability, and safety analysis will be performed to provide input to the preparation of waste package design requirements and to guide further testing. Initial geochemical modeling of basalt/groundwater and packing/groundwater hydrothermal interactions will be completed.

In tuff, testing will be done to determine the stability of clays and zeolites under the hydrothermal conditions that will follow waste emplacement. The phenomenon of fracture healing, observed under saturated conditions, will be investigated under conditions of unsaturated flow, and the effect of fractures on the distribution of water during dehydration and rehydration of rock under isothermal conditions and in a temperature gradient will be examined. Testing of West Valley glass under unsaturated conditions will be completed. Work will continue along two parallel efforts for stainless steels and for copper-base materials (assuming that the corrosion performance of Cu merits continuation of that alloy system). The two parallel efforts will converge at the end of FY 1987 with selection of one material. Prototype testing and data analysis will be completed on the advanced conceptual design. The preliminary waste package system model and geochemical data base will be updated and used to analyze the performance of advanced conceptual waste package designs.

In salt, testing will continue to further define the waste package near-field environment. Radiation and heat effects studies on brine composition will be completed. Data and analysis reports for waste form and barrier materials testing will be issued to support the waste package design specification, and data collection for performance assessment model development will be completed. The waste package design specification will be prepared utilizing data from the waste form and barrier materials testing. Welding and inspection technique demonstration testing will be completed, and large-scale package component tests will be initiated.

3. Siting.. $150,100

Site characterization activities will continue at each of the three candidate sites. A significant effort will be focused on analysis of geotechnical data to assist in the preparation of input for the Site Recommendation Report and Draft Environmental Impact Statement (DEIS). Environmental characterization and socioeconomic analyses will continue in FY 1987 for each site.

At basalt, if selected, borehole facilities will be installed to support establishment of the site flow system baseline and hydrochemical sampling. Groundwater monitoring, hydraulic testing, solute transport testing, and hydrochemical sampling will continue. Geologic characterization will continue to provide data and interpretations supportive of design and performance assessment evaluations. Borehole and surface studies will be conducted to provide input to an update of three-dimensional stratigraphic and structural model of the Reference Repository Location (RRL), which will serve as the geologic basis for conceptual geohydrologic modeling and repository design input. As part of this effort, deep boreholes will be drilled to characterize the central to eastern RRL, particularly for the purpose of assessing the potential for repository panel development in that direction if required. Evaluation of the tectonic setting of the RRL will continue through the conduct of geologic mapping, geophysical surveys, and seismic monitoring, and through an evaluation of structure-verification and other borehole data. Data acquired through tectonic studies will be used to update tectonic models of the RRL and surrounding region to document preliminary seismic design input to the repository LA design.

At tuff, if selected, the drilling program will be accelerated and will include unsaturated zone hydrologic studies. Sufficient data should be available to provide preliminary site geology and subsurface fracture description. Additional core will be obtained, described, and its physical properties measured and correlated with the geophysical logs. Soil studies and surface deposit maps to locate quaternary fault movement will also be completed. Monitoring and analysis of the regional and site seismic network will continue. The recharge modeling studies will be completed. The tracer studies will be concluded and the data obtained will be used to model the flow system in fractured rock. The travel time evaluation in the saturated zone will be completed as well as the simulated flow path through Yucca Mountain. An effort will be initiated to describe the unsaturated zone hydrologic system based on the available geologic and hydrologic data. The effects of future tectonic activity on the locations and rates of erosion will be modeled.

In salt, three hydrology clusters consisting of three wells each will be drilled into the deep aquifer. These wells will provide data to establish hydrogeologic parameters of the aquifer unit, the rate and direction of flow, and potentiometric levels for input to performance assessment modeling. The clusters will be located offsite, but within a few miles of the exploratory shaft facility to contribute to the confirmation and further development of the regional hydrologic model of the setting. These are three of five clusters that are planned. The stratigraphic boreholes will be completed and drilling of approximately 400 shallow foundation within a few miles of the exploratory shaft facility to contribute to the confirmation and further development of the regional hydrologic model of the setting. These are three of five clusters that are planned. The stratigraphic boreholes will be completed and drilling of approximately 400 shallow foundation borings for repository surface facilities will be completed. Surficial geologic mapping of the site and access routes will be accomplished. Geologic analyses of data from the Engineering Design Borehole (EDBH), stratigraphic boreholes, and exploratory shaft facility borings will be performed. Regional and site-specific geologic studies will be undertaken for input to preparation of licensing and permit documents. Geophyscial surveys (seismic, gravity, magnetic, resistivity) begun in FY 1986 will be required to help resolve issues identified during the site characterization activities. The microseismic network, used to monitor seismic activity, will continue to be operated and maintained. Final decommissioning and closeout for the last of the deferred field activity locations and records turnover will be completed.

4. Repository Development.. $ 87,800

In FY 1987, the repository advanced conceptual design reports will be nearly completed for each of the three candidate sites. The development of repository LA design criteria which will be based on the previous design activities, engineering trade-off studies, and the repository data base, will be initiated. Engineering development of repository equipment and instrumentation will continue. Repository seal in situ tests will be initiated.

At basalt, samples from the exploratory shaft facility and Near Surface Test Facility (NSTF) will be evaluated in the laboratory in order to update the repository geomechanics behavior and repository functional design criteria. Detailed test designs will be prepared for in situ triaxial and direct block shear tests. Instrumentation specifications and testing requirements will be scoped to place prototype instruments in the exploratory shaft. At tuff, a full demonstration of the system for horizontal waste emplacement and retrieval will be conducted. In salt, evaluation of emplacement parameters and engineering properties for clay-based sealing materials will be completed. Rock mass characterization criteria and interim specifications for emplaced concrete/grout, salt, and clay seals will be developed. Site-specific rock testing will be performed on the potential repository horizon and adjacent nonsalt rock units. Laboratory testing in support of site characterization, repository design, exploratory shaft, and performance assessment will continue.

5. Regulatory and Institutional................................... $ 49,600

Site-specific data from the characterization and design activities will be analyzed for incorporation into semiannual SCP progress reports. Preparation of the license application will be initiated and close coordination with NRC and EPA will continue. Consultation with affected States and Indian Tribes, public information programs and other communications and institutional liaison activities including financial assistance to States and Indian Tribes will continue. Grants will be provided equal to taxes to States where site characterization is being conducted, as appropriate.

6. Exploratory Shaft.. $133,500

In basalt, drilling of the first shaft will be initiated and definitive design of the second shaft and subsurface excavations will be completed. Surface facility construction will proceed concurrently with drilling operation. Construction of the hoist house will be completed to support the start of shaft outfitting. A readiness review and supporting safety analysis will be completed for the first shaft to support entry of personnel into the shaft for outfitting. Tests to be conducted in the exploratory shaft will be mocked up in the NSTF to train personnel and to verify the suitablility of the test design for use underground. Tests will be fabricated, installed in the NSTF, and reworked as necessary when underground development in the exploratory shaft is completed.

In tuff, the exploratory shaft site preparation will be completed. Shaft sinking, lining and outfitting with internals and utilities will begin with scheduled interruptions for testing as required. Off-site development work on in situ tests will continue as will laboratory work on samples obtained during shaft construction.

In salt, field mobilization activities for construction of the exploratory shafts will be completed and all the exploratory shaft facility permits will be obtained. Site preparation and surface facility construction will begin. Procurements of instruments to be installed during the excavation of the shafts and components required for the data acquisition system will be initiated. Instruments procured will be calibrated and the acquisition system will be operated to correct any operational problems prior to installation at the site.

7. Test Facilities.. $5,200

Domestic test facilities will be operated in support of the geologic repository program and cooperative international programs will be conducted at selected foreign facilities. At basalt, the Basalt Materials Research Laboratories and the Near Surface Test Facility will be operated and maintained in support of the waste package and repository test programs. At tuff, the G-Tunnel will be maintained as a test bed for equipment development, specifically the proof-of-concept testing required for evaluation of the horizontal drilling equipment proposed for horizontal waste package emplacement. The Climax Test Facility will also be maintained to facilitate institutional interactions. At salt, the cooperative program on brine migration tests will be continued with the Federal Republic of Germany at the Asse Mine; interactions will be conducted with the Waste Isolation Pilot Plant (WIPP), evaluating WIPP data for use by the Salt Repository Project and considering in situ tests in support of project requirement; and access to the Avery Island facility will be maintained to obtain salt samples for testing.

8. Land Acquisition... $ 7,600

The Department will continue proceedings to obtain land access for non-government owned land in the salt media needed for the repository controlled area. The intent is to protect the potential site from intrusion and new mining claims.

9. Project Management... $ 44,200

Project management and support functions will continue to be provided for the geologic repository projects. These functions include assistance in updating project planning documents, operation of project cost and schedule control systems, financial management and budgeting, procurement and management of subcontractors, legal services, records management, and operation of a quality assurance program that meets NRC requirements.

A. First Repository - FY 1988 Estimate

FY 1988 Estimate.. $632,400

As stated earlier, the Act requires DOE to submit a triennial budget for authorization purposes. The following activities would be initiated, continued, or completed in FY1988.

1. Systems.. $ 23,400

Operation of the data base management system and conduct of system engineering analyses for each project will continue. Project integration support will continue to ensure that data acquisition, analysis and documentation are focused on issue resolution in support of meeting site characterization goals prior to license application. Efforts on computer code verification, validation, benchmarking and documentation will also continue. Preliminary performance assessments will be conducted to support preparation of the draft Environmental Impact Statement.

2. Waste Package.. $ 37,900

Waste package design and development will continue at each of the three candidate sites. At each site, the advanced conceptual design of the waste package will be completed. This work will enable continuing input into demonstrating the performance of the waste package in meeting the 300-1000 year containment regulatory requirement and in contributing to meeting the release rate regulatory requirements. For all projects, container materials testing will continue to provide data for input to the development of waste package designs.

In basalt, testing will accelerate in all areas including waste acceptance compliance test development, materials testing, development testing, and qualification testing. Materials testing of the reference and backup container metals will focus on corrosion and mechanical properties, long-term behavior with and without radiation, and on corrosion product characterization. Two additional small-scale, heated model corrosion tests will be operational and a detailed design will be prepared for a large-scale, heated model corrosion test. The container closure and non-destructive examination processes will be demonstrated for both reference and backup materials.

In tuff, the final laboratory scale experimental studies of the hydrologic properties of Topopah Spring tuff will involve two phase flow under unsaturated conditions in rock samples that contain multiple fractures. The chemistry of water reacted with the rock cores under unsaturated conditions during the flow experiments will be compared with that from saturated hydrothermal testing. The geochemical modeling of zeolite and clay hydrothermal reactions, and the effects of variations in water chemistry will continue. Hydrothermal interaction tests will be conducted using rock samples obtained from the repository horizon during exploratory shaft construction. Container material for the waste package final design will be selected and activities will focus on confirmatory testing on corrosion/oxidation rates and degradation modes established previously. Carbon steel borehole liner material will be examined to determine the effects of alloy composition, microstructure, and welding on the performance of the steel.

In salt, waste package environment and waste form and materials testing will continue with a report issued to support the waste package design. Single effects testing will be completed with major emphasis on expected condition interaction testing.

A. First Repository - FY 1988 Estimate

Unanticipated events testing will be initiated to support future licensing actions. Also, performance assessment of the waste package advanced conceptual design will be completed. Waste package model development will be completed and validation activities continued. Large-scale waste package component tests will also continue.

3. Siting.. $139,700

Site characterization activities will continue at each of the three candidate sites. Site characterization planning and implementation will support the exploratory shaft development program and testing, repository design, and SCP progress reports. All projects will continue monitoring the environmental impacts of site characterization. A comprehensive environmental assessment program will be implemented to support the EIS and other licensing documents. Climatic and air quality monitoring, and socioeconomic analyses will continue and will be used to support impact mitigation plans as necessary.

In basalt, geologic characterization of the stratigraphy, structure, rock chemistry, tectonic setting, and resource potential of the RRL and surrounding area will continue. Work will focus on providing data and interpretations supportive of design and hydrologic and performance assessment evaluations. Input from such analyses will be utilized to update a three-dimensional stratigraphic and structural model of the RRL, which will serve as the geologic basis for conceptual geohydrologic modeling and repository design input. Stratigraphic and structural data will be provided from exploratory shaft tests. In preparation for such work, a report will be produced on the predicted intraflow structure and primary fracture conditions in the preferred candidate horizon within the exploratory shaft. Evaluation of the tectonic setting of the RRL will continue through the conduct of geologic mapping, seismic monitoring, geophysical and geodetic surveys.

In tuff, large-scale hydraulic and tracer tests will be conducted and the data integrated with the water table description in the saturated zone hydrology model. The geologic model will be established as well as a preliminary unsaturated zone hydrology model. Data from core samples will be evaluated using standard climate-calibration techniques in order to determine past climatic conditions. The potential for radionuclide transport will be determined and solubility measurements for radionuclides specified in 40 CFR 191 will be completed. Also, the effectiveness of matrix diffusion in mitigating the release of radionuclides in fractured tuff will be demonstrated. The geothermal model of the saturated zone including a final analysis of transport in the saturated zone will be completed.

In salt, the remaining two of the five hydrology clusters will be drilled into the deep aquifer. These wells will provide data to establish hydrogeologic parameters of the regional flow system. These clusters will be located several miles from the exploratory shaft facility to contribute to the validation process of the regional ground-water flow model. Comprehensive hydraulic testing will be performed in completed wells of the deep hydrology clusters. Tracer tests and fracture flow studies will be performed. Approximately 200 wells will be drilled to the water table for the purpose of detecting changes in ground-water quality during and after the operational phase of the repository facility. Most testing on the rock from the EDBH and stratigraphic boreholes will be completed. Most soils testing will also be completed. The microseismic network will continue to be operated and maintained.

A. First Repository - FY 1988 Estimate - continued

4. Repository Development... $126,000

Preparations to start the repository Licenses Application (LA) design will be completed for each of the three candidate sites. Engineering development of repository equipment and instrumentation and repository seal in situ testing will continue.

At basalt, rock mechanics laboratory tests will be completed using cores from the exploratory shaft. Long term studies of rock support materials will continue, a report on waste handling equipment development will be completed, and an instrumentation development plan will be prepared based on the respository advanced conceptual design. At tuff, rock mechanics analyses will determine the impact of data from the in situ experiments conducted in the exploratory shaft. Seal performance analyses will be completed and a prototype waste transporter and associated handling equipment will be fabricated for testing. At salt, final specifications for concretes/grouts used in sealing applications will be issued. Large-scale testing of emplacement and field verification of clay-based sealing materials will be completed. Work will continue on development of a field testing technique to determine the in situ stress conditions in salt over varying time intervals. This technique will aid in room and pillar design and also determine the orientation of the repository layout.

5. Regulatory and Institutional....................................... $ 58,000

Coordination with NRC and other regulatory agencies will continue. Semi-annual SCP progress reports will be prepared. Consultation with and assistance to affected States and Indian Tribes, public information programs, and other communications and institutional liaison activities will continue. Preparation of the required license application documents will be continued at each project. Grants will be provided equal to taxes to states where site characterization is being conducted, as appropriate.

6. Exploratory Shaft.. $190,600

At basalt, construction of the first exploratory shaft will be nearly completed, including grouting and lining with a 72-inch liner. The drill rig will be demobilized immediately after drilling to depth, and moved to the second shaft site. While the first shaft is being outfitted, the second shaft will be drilled. Surface construction for the second exploratory shaft will be conducted in parallel with drilling of the second shaft. The hoist house will be constructed in preparation for outfitting and acceptance of the second shaft. Training of personnel and hiring of underground crews for installation and performance of testing in the exploratory shaft will be initiated.

In tuff, the shaft and the mining subcontractor will sink, line, and outfit the first shaft with internals and utilities, and construct the shaft bottom drill room. The operating contractor will mobilize to support the testing activity. This will allow test equipment to be installed continuously in order to start tests as soon as practicable.

In salt, construction of the surface facilities will be completed and construction of both shafts will begin. The detailed test procedures required to characterize the site by subsurface monitoring and testing will be completed and instruments will be installed in the shafts under construction. Procurement activities will be initiated for the acquisition of the subsurface instruments, orders will be placed for long-lead and specialized equipment to be fabricated, and plans will be prepared to mobilize to the site for subsurface testing.

7. Test Facilities.. $ 4,800

Operation of domestic test facilities in support of the waste package and repository test programs will continue, including the Basalt Materials Research Laboratories and the Near Surface Test Facility at basalt, the G-Tunnel and the Climax Test Facility at tuff, and the Avery Island facility at salt. Interactions between the Salt Repository Project and the Waste Isolation Pilot Plant (WIPP) will be continued to evaluate WIPP data. The Cooperative program on brine migration tests with the Federal Republic of Germany at the Asse Mine will be completed.

8. Land Acquisition.. $ 4,000

The Department will continue to manintain land access for non-government owned land in the salt media to protect the repository controlled area from intrusion and new mining claims.

9. Project Management.. $ 48,000

Project management and support functions will continue to be provided for all geologic repository projects. These functions include assistance in updating project planning documents, operation of project cost and schedule control systems, financial management and budgeting, procurement and management of subcontractors, legal services, records management, and operation of a quality assurance program that meets NRC requirements.

FY 1989 Estimate.. $571,500

As stated earlier, the Act requires DOE to submit a triennial budget for authorization purposes. The following activities would be initiated, continued, or completed in FY 1989.

1. Systems... $ 22,100

Operation of the technical data base management system will continue, with significant additional data being incorporated from the site characterization activities and from the waste package and repository design efforts. An evaluation of the performance of the site, waste package, and repository subsystems will be conducted for input to the draft EIS. The validation of computer codes will approach completion and the analysis of radioactivity releases from the total system will provide predictions of long-term impacts and demonstrate compliance with regulations.

2. Waste Package... $ 38,000

The waste package LA design will begin early in the year, with emphasis on conducting the major performance, reliability, and safety analysis for input to the LA and draft EIS. In basalt, preliminary waste acceptance specifications will be issued in preparation for the LA. A preliminary report will be completed which describes the effects of alpha radiation on radionuclide sorption and diffusion in packing materials. A report will be issued on the evaluation of container materials testing including corrosion and fracture mechanics tests on coupons and small-scale heated container model tests. These tests will demonstrate the validity of extrapolating coupon test data to large-scale container performance.

In tuff, the first series of hydrothermal interaction tests of Topopah Spring tuff obtained from repository depth and using water chemistry appropriate to the unsaturated zone will be completed. Assembly of the final waste package environment data base to support performance assessment activities prior to and during license application will begin. Zircaloy corrosion testing will be completed. Tests on interaction of radionuclide solutions with the very near-field rock will be completed. An integrated data base on waste form release will be finalized. The detailed specifications and drawings will be completed, and work on development of the license application design will continue. Verification and validation of the waste package system model will be completed.

In salt, in situ testing will be initiated and near-field conditions will be updated. The final waste form and materials testing laboratory reports supporting package design will be issued. Large-scale waste package component tests will completed. Long-term in situ and laboratory confirmation testing plans will be finalized. Waste package performance assessment activities supporting the license application will be initiated.

3. Siting.. $108,500

Site characterization activities will proceed at each of the three candidate sites. At basalt, hydraulic testing and hydrochemical sampling in the exploratory shaft will continue. Groundwater monitoring, hydraulic testing, and solute transport testing will continue. Analyses of the regional flow system, hydraulic properties, ground water evolution and solute transport characteristics will continue. Geologic studies will continue utilizing data acquired from surface, borehole and exploratory shaft samples. Integration and documentation of geologic data will be focused on providing geologic interpretations in support of DEIS and LA needs.

In tuff, the drilling program will be completed. A report will be issued for rock and water samples being curated and tested. The saturated zone model update will be completed. The future climate studies will be integrated and completed. The conceptual model for tuff/water interactions at Yucca Mountain will be completed. The effectiveness of Yucca Mountain in filtering particulates from groundwater will be demonstrated by laboratory as well as field measurements. Stochastic methods will be established to allow calculation of the effect of uncertainties in the Yucca Mountain properties on transport. The final geochemistry model of the saturated zone will be completed. Preliminary geologic, hydrologic, and geochemical models of the site will be provided for use in preliminary performance assessment calculations.

At salt, samples from the exploratory shaft facility will be available for testing to support development of a site-specific evaluation of the thermal, thermomechanical, and mechanical properties of the repository horizon. Laboratory testing will refine and support the in situ testing program. Stratigraphic and structural studies will continue, as will geochemical analyses of isotopes, rock-water interaction, formation brines, and clay minerology. Site hydrologic system performance analysis will be conducted, with the results provided to systems performance assessment for license application. Comprehensive hydraulic testing will be performed in all remaining completed wells. Tracer tests and fracture flow studies will be performed.

A. First Repository - FY 1989 Estimate - continued

4. Repository.. $141,000

The repository License Application design will begin early in the year at each of the three candidate sites. Rock mechanics work will continue at basalt using data from the exploratory shaft. The empirical behavior of the exploratory shaft rock support systems will be defined and preparation of test designs for the instrumentation development program will begin. At tuff, rock mechanics analyses will evaluate exploratory shaft data to quantify the variability of properties as input to licensing analyses. Data and results will be forwarded to the facilities, design, sealing development and performance assessment areas as they become available. Equipment development will focus on completing the demonstrations necessary to prove that technology exists for waste emplacement and retrieval under adverse conditions. At salt, site-specific data will be integrated into the final salt creep model. Waste handling equipment demonstration testing will be completed. The final repository seal material model will also be completed, as well as the preliminary tests of backfill emplacement techniques.

5. Regulatory and Institutional... $ 64,400

Coordination with NRC and other regulatory agencies will continue. Semi-annual SCP progress reports will be prepared. Consultation with and assistance to affected States and Indian Tribes, public information programs, and other communications and institutional liaison activities will continue. Preparation of the required license application documents will be continued at each project. Grants will be provided equal to taxes to States where site characterization is being conducted, as appropriate.

6. Exploratory Shaft.. $140,900

At basalt, outfitting of both shafts will be completed. Porthole testing of the first shaft will be conducted to determine the integrity of the grout seal, and to evaluate the disturbed rock zone around the shaft. A safety analysis and readiness review to support breakout from the first shaft will be completed, and breakout and mining of the shaft station will also be completed. The Phase I test reports will be completed. Construction of the underground drifts, including installation of utilities, wire ways, electrical power, data acquisiton channels, sumps and sump pumps will be initiated.

At tuff, construction of the underground excavations and the second shaft will be completed, the test program will be implemented following completion of construction. Operations management, test direction and coordination, safety, and quality assurance personnel will be provided on a three shift per day basis. The test plan will be continually updated and coordinated with the semi-annual SCP progress reports. The operating contractor will provide site maintenance, metered power, transportation services, fire protection, first-aid/ambulance service, communications, safety, and environmental services along with operations support of the facility and direct support to the testing on a three shift per day basis.

Construction work associated with the salt exploratory shafts and supporting facilities will be nearly completed. The construction manager will operate all facilities to support in situ testing, which will begin after the two shafts have

A. First Repository - FY 1989 Estimate - continued

been connected. Instrumentation installed in the shafts will be monitored, calibrated instrumentation will be installed at depth, and testing will begin. Initially, data will be obtained to verify that subsurface conditions match those predicted from the surface based characterization program.

7. Test Facilities.. $ 4,400

Operation of domestic test facilities in support of the waste package and repository test programs will continue, including the Basalt Materials Research Laboratories and the Near Surface Test Facility at basalt and the Climax Test Facility at tuff. Work will be completed at the G-Tunnel in tuff and at the Avery Island salt facility. Liaison with the Waste Isolation Pilot Plant will be continued.

8. Land Acquisition... $ 4,000

The Department will continue to maintain land access for non-government owned land in the salt media to protect the repository controlled area from intrusion and new mining claims.

9. Project Management... $ 48,200

Project management and support functions continue to be provided for all geologic repository projects. These functions include assistance in updating project planning documents, operation of project costs and schedule control systems, financial management and budgeting, procurement and management of subcontractors, legal services, records management, and operation of a quality assurance program that meets NRC requirements.

	FY 1986 Appropriation	FY 1987 Request	FY 1988 Estimate	FY 1989 Estimate
B. Second Repository - Total	$35,500	$78,700	$74,200	$71,500

The objective of this program is to carry out the activities to site and design the second repository as mandated by the Act. As was the case with the first repository, the second repository's FY 1987 activities are discussed by functional program work breakdown structure.

The second repository program will be conducted with decision points spaced about seven years from those for the first repository. The FY 1987 request supports a FY 1993 recommendation of candidate sites for characterization for the second repository. Potential sites to be considered for a second repository could be drawn from several sources. First, sites identified as potentially acceptable but not nominated for the first repository could be considered. Secondly, sites characterized for the first repository but not selected could be considered. Finally, sites from among geohydrologic settings and rock types not considered for the first repository but developed at a later date could, if found potentially acceptable, be considered for the second repository. Currently, the Department is conducting studies to identify potentially acceptable sites in crystalline rock in three regions of the country. The Department is also conducting studies for investigating sedimentary rock to determine if that media might contain potentially acceptable sites. The planned milestones leading to the site recommendation and license application decisions for the second repository are shown below.

Milestones	Calendar Year	
o Issue final region to area screening methodology	April	1985
o Issue final Regional Characterization Reports	September	1985
o Issue draft crystalline rock Area Recommendation Report	January	1986
o Issue final crystalline rock Area Recommendation Report	November	1986
o Issue draft crystalline rock Area Characterization Plan (ACP)	February	1987
o Issue final ACP and initiate crystalline rock area phase field investigations	November	1987
o Recommend candidate sites to President for characterization		1993
o President recommends repository site to Congress		1999
o Submit license application to NRC		2000
o Receive construction authorization from NRC		2002
o Begin operations		2008

In addition to intensive study and characterization of crystalline rock formations, the program efforts include waste package design and development, repository design, geosciences, materials development, and other related technical fields.

B. Second Repository - continued

FY 1987 Congressional Budget Request.................................... $78,700

The budget request for FY 1987 reflects an increase of $43,200,000 over the FY 1986 appropriation. The increase will provide for: preparation for area phase field studies in the crystalline rock repository project; expanded cooperative efforts with the Atomic Energy of Canada Limited/Underground Research laboratory and the Swedish/Stripa projects; grants to affected States and Indian Tribes; and engineering activities related to waste package and repository design.

1. Systems.. $ 5,900

The development and application of technical integration techniques and procedures for the CRP will be a major component of this WBS element. A substantial activity will be devoted to the coordination and integration of the Area Phase Methodology (APM) which will be used in the prioritization of area phase data needs and finally in the comparative analysis required to support site nomination and recommendation in conjunction with the Environmental Assessments. The importance of public concerns relating to transportation of nuclear waste will be reflected by an emphasis in transportation-related studies in support of the area phase.

Performance assessment activities will emphasize the evaluation of postclosure radiological performance capabilities of each candidate area. Activities will continue toward the refinement and selection of fracture flow and transport models and codes that can be verified and validated for use in subsequent phases of the project, and efforts will be devoted to the acquisition and application of models to support repository and waste package design studies. The development of the CRP Technical Data Base Management System (TDBMS) will be completed, to be available for receipt of data related to the area phase.

2. Waste Package.. $ 1,100

The design bases for the waste package will be drafted and and a program plan for the development and testing of waste package materials will be prepared and reviewed. Preliminary scoping analyses of waste package performance will also be conducted in the initial application of waste package models to a repository in crystalline rock.

3. Siting.. $ 45,700

The final Area Recommendation Report will be issued, following modification of the draft as appropriate in response to comments on the draft. Geotechnical work will be directed toward completing the draft Area Characterization Plan (ACP), which describes field activities to commence during the next fiscal year. The draft ACP will identify candidate-area specific plans for the conduct of investigations in geology, hydrology, geochemistry, and tectonics, as well as in the areas of the environment and socioeconomics. Preparation of the ACP will also involve interactions with the States and affected Indian Tribes through a workshop process to receive their input on studies proposed and their applicability. In addition, detailed test plans and procedures will be developed for specific field activities and are to be tested at trial study sites in Canada as part of the AECL cooperative program. These tests will include two deep drill holes at the Atikokin site in Canada and the conduct of hydrologic testing in the holes. Limited data are to be collected and reviewed on each area to be studied during area characterization. These data will include remotely sensed imagery and geologic and hydrologic data obtained from Federal and State sources. To prepare for field testing, equipment needed to perform hydrologic and geochemical tests will be evaluated and acquired.

Environmental activities will include contributions to the preparation of the draft ACP, including mapping and data collection programs. Specific techniques best suited for comparatively evaluating the candidate area will be identified. Preparation of field test plans and procedures that will provide detailed guidance for the conduct of planned field investigations will be continued.

Socioeconomic activities will be conducted to support preparation of the draft ACP. Specific plans for the conduct of studies of population distribution and density, regional economics, housing, public services and facilities, government expenditures and revenues, water and other resource usage, and related topics will be formulated.

4. Repository Development.. $ 3,800

Existing repository conceptual designs from the first repository and foreign programs will continue to be evaluated. Shaft, shaft seal, and underground layout design studies will be started. The generic conceptual design of the exploratory shaft will be evaluated for potential use as one of the repository shafts. Repository design information will be provided to support State briefing meetings. Engineering design input will be provided for the geomechanics and repository design chapters of the draft Area Characterization Plan.

Procurement of a rock mechanics laboratory testing contractor for the area-phase thermomechanical data base development will be completed. This contractor will receive core samples from Stripa and the Canadian URL and begin development of the mechanical, thermal, and thermomechanical data base needed for the design of the exploratory shaft and the repository.

5. Regulatory and Institutional.. $ 8,900

Changes to the regulatory requirements will continue to be monitored and analyzed as to potential impact on the crystalline repository project. Oversight will be provided for state permitting, waste disposal-related laws and environmental laws applicable to area phase field investigations. The Regulatory Compliance Plan and Regulatory Milestone Chart will be updated to reflect regulatory changes and a preliminary draft Environmental Assessment management plan will be prepared. The Regulatory Review Group will continue to provide an independent review of regulatory activities.

Institutional activities in the communications and liaison area will focus on consulting with States and Indian tribes regarding area phase planning. Grants will be made available to affected States and Indian Tribes to support their independent review of project documents, to attend workshops and meetings, to facilitate exchange of information, and to provide mechanisms for negotiation with DOE on key issues.

6. Exploratory Shaft.. $ -0-

No activities planned.

7. Test Facilities.. $ 7,500

In a joint project effort between DOE and the Atomic Energy Canada Limited (AECL), design of the Mine-By Experiment and test plans for the Heated Block Experiment at the Underground Research Laboratory (URL) will be completed. Planning for the URL Single-Fracture Migration/Sorption, and Container/Buffer Experiments will be initiated.

Instrumentation of the Mine-By Experiment will also be started. Grouting and excavation of the fracture zone at the URL will be conducted, and the shaft will be deepened to a depth of 440 meters.

Thermal/Mechanical/Hydrologic testing will be completed at the Colorado School of Mines. Long-term instrumentation testing will be planned and initiated. Cooperation on the OECD/NEA Swedish Stripa Project will continue with Phase III testing.

8. Land Acquisition.. $ 800

Activities will focus on securing all required permits for early area phase field investigations. Work will also proceed to update the Land Access/Acquisition Plan to ensure that the scope and contents of the plan are kept current in the face of anticipated legislative/regulatory changes.

9. Project Management.. $ 5,000

Activities will include contractor support in financial management and budgeting, procurement planning, administrative support services, cost/schedule planning and analysis, developing and maintaining a quality assurance program and overall planning, coordination and management.

FY 1988 Estimate.. $ 74,200

1. Systems.. $ 4,500

Increased emphasis will be devoted to the application of System Engineering concepts for the technical integration of the project. The development of the comparative analysis methodology will be refined, including the addition of a weighting process compatible with that used in the first repository nomination process. The methodology will be applied in support of the area phase activities to supply guidance in their conduct, and to allow early evaluation of their potential in satisfying the DOE Siting Guidelines. Performance assessments will be refined as better data and analytical techniques become available. The results will in turn be used with data from measurements in the candidate field areas to both substantiate the appropriateness of the codes and models and to supply guidance to the conduct of the field measurements, and to the location of the preferred initial drill site. The Technical Data Base Management System will be in operation, accumulating the project data relating to the area phase and maintaining public access to this data base.

2. Waste Package.. $ 1,600

Development of waste package design concepts will be initiated and structural and cost analyses based on the design concepts will be conducted. The thermal, chemical, and structural constraints within which acceptable waste package designs can be developed will be identified. Descriptions will be developed for waste packages containing spent fuel and other material designated as requiring disposal in a mined geologic repository.

B. Second Repository - FY 1988 Estimate - continued

Based on the waste package strategy and planning documents developed in the previous fiscal year, test plans for waste package materials and for characterization of the waste package environment will be drafted. Included will be plans for the testing of spent fuel, container materials, and packing materials and for studies of groundwater radiolysis and of thermal and radiation affects on the host rock. Also, model development and application to the assessment of waste package performance will be continued.

3. Siting.. $ 44,800

Geotechnical field investigations will begin after the final ACP is issued. Investigations on each area will focus on obtaining surface information to identify drill sites as well as provide data to refine conceptual models of the hydrology and geology of each area. Shallow drilling will be done to calibrate the geophysical model input. Outcrops of rock as well as springs and water bodies will be sampled for geochemical analyses to evaluate surface geochemical conditions that may indicate connection to deep flow systems. Hydrologic surveys of existing wells and water bodies are to be done to provide information for refining the hydrologic conceptual model.

Environmental activities will be focused on the conduct of field investigations. The initial thrust of these activities will be to perform those reconnaissance level field studies and verifications required to support the identification of specific drill sites. Environmental investigations will foucs on aquatic ecology, terrestrial ecology, meterology, climatology, air quality, surface water hydrology, background radiation, topography, soils and on/off-site hazards analyses, land use and status, cultural, archaeological, and historical resources, and aesthetics. Development of the Area Phase Methodology will be refined as information is collected during the fiscal year.

Socioeconomic investigations will concentrate on the following topics: population density and distribution; regional economics; housing; public services and facilities; government expenditures and revenues; water and other resource usage; recreational resources/facilities and transportation. Information will be obtained from open literature/secondary sources and from field reconnaissance investigations. This information will be collected to prepare or update existing baseline socioeconomic maps and data.

4. Repository Development.. $ 2,600

Geologic field testing and environmental and socioeconomic data collection during the intial area phase investigations will be factored into design of repository shaft, shaft seals, and surface/underground layouts. Laboratory rock mechanics testing will continue. A sealing materials test plan will be developed to support scheduling and cost estimates for sealing materials characterization and design data development. Development of performance assessment codes will be started to conduct analyses of the performance of the repository structures and engineered barriers within the geologic site.

5. Regulatory and Institutional...................................... $ 8,400

Changes to the regulatory requirements will continue to be monitored and analyzed as to potential impact on the crystalline repository project. Regulatory interpretation and guidance will continue to be provided to support activities conducted in the latter portion of the area phase. Oversight will continue for state permitting, waste disposal-related laws and environmental laws applicable to area phase site

B. Second Repository - FY 1988 Estimate - continued

investigations. The Regulatory Compliance Plan and Regulatory Milestone Chart will be updated to reflect changes in the environment. A revised draft EA management plan will be prepared as well as a preliminary draft SCP management plan. The Regulatory Review Group will continue to provide an independent review of regulatory activities.

Institutional activities in the communications and liaison area will focus on consulting with States, Indian Tribes, legislators, citizens groups, and other involved constituencies regarding the nature of field work activities. Grants will be made available to affected States and Indian Tribes to support their independent review of work being conducted, to attend workshops and meetings, to facilitate exchange of information, and to provide mechanisms for negotiation with DOE on key issues.

6. Exploratory Shaft.. $ 300

Generic exploratory shaft conceptual design requirements will be developed using experience gained from the first repository and international programs. The development of an in situ test program will be initiated for a typical crystalline rock mass. The planning will include indentification of key parameters such as in situ stress state and hydraulic conductivity.

7. Test Facilities.. $ 7,200

Instrumentation of the Mine-By Experiment at the AECL Underground Research Laboratory (URL) will be completed, and excavation for the test will begin. Design of the Block Experiment will be completed, as well as planning for the Migration/Sorption Experiment and the borehole sealing investigation. Shaft characterization activities at the URL will also be completed, and excavation of the lower level will begin. Test planning for the pressure chamber will be initiated.

Participation in the Swedish Stripa Project will continue, as will cooperation with the Swiss and French programs with a limited staff exchange and data transfer between programs.

8. Land Acquisition.. $ 600

Land access activities, including detailed planning required to help ensure land access for area phase investigations, will be continued. Also, planning will begin for the land acquisition required for site characterization. The Land Access/Acquisition Plan will be updated.

9. Project Management.. $ 4,200

Activities will include contractor support in financial management and budgeting, procurement planning, administrative support services, cost/schedule planning and analysis, developing and maintaining a quality assurance program, and overall planning, coordination and management.

B. Second Repository - continued

FY 1989 Estimate	$ 71,500

1. Systems	$ 4,000

Systems engineering activities will be continually applied to the project technical integration. The APM will be in use on a continuing basis to compare the potentially acceptable sites and assess the need for and validity of area phase data. Performance assessments of potentially acceptable sites will continue, using the increasingly detailed and comprehensive data from field activities. The TDBMS will be in full use as the central technical data base for the CRP.

2. Waste Package	$ 1,700

The development of waste package design concepts will be continued and a proposed waste package description will be prepared. The study of waste package components will be completed. The draft test plans for waste package materials and environment will be completed. The procurement of test materials and equipment will be initiated. Performance assessment of waste packages using area-phase data will be initiated.

3. Siting	$ 43,200

Field investigations in each area will continue with the emphasis shifting from surface oriented studies to subsurface investigative techniques. Drilling and coring of holes will be done to obtain information on the at depth rock properties and structures such as faults and fractures. Testing will be conducted at the proposed repository level to determine in situ geologic, geochemical, geomechanical, and hydrologic parameters. The drilling program will include shallow and deep holes drilled at selected locations either within the area or immediately adjacent to it. The objective of the drilling will be to characterize the subsurface conditions adequately to refine the geologic and hydrologic conceptual models of the area for comparative evaluation and mathematical modeling purposes. Geochemical analyses will be performed on rock and water samples obtained from drilled and cored holes. The holes will also be tested using geochemical probes to determine in situ geochemical properties to evaluate waste/rock and water/rock interactions. All holes will be geophysically logged and hydrologically tested using straddle packers to provide data on the in situ hydrology and geologic conditions.

Environmental and socioeconomic field investigation activities will be continued. Data collected in FY 89 from these activities will be utilized, along with previously compiled data, to improve the environmental and socioeconomic sector models.

4. Repository Development	$ 4,500

The review of existing repository conceptual design efforts from the first repository and international programs will continue. The sealing design studies will be updated to provide input to the sealing materials laboratory testing efforts. Engineering design studies on shafts and subsurface excavations will continue, and design modifications will reflect geotechnical and geohydrologic borehole information obtained during area-phase field testing. The systems description will be updated based on information from the design studies.

B. Secondary Repository - FY 1989 Estimate - continued

Thermomechanical laboratory rock properties data will continue to be developed with core samples obtained from the potentially acceptable sites. This new rock mechanics data base will be put into the technical data base and be used in updating shaft and underground excavation designs. Performance assessment codes will continue to be developed for evaluation of repository conceptual designs.

5. Regulatory and Institutional.. $ 7,900

Changes to the regulatory requirements will continue to be monitored and analyzed. State related regulatory activities will begin the transition from area phase requirements to detailed site characterization permitting requirements. The Regulatory Compliance Plan and Regulatory Milestone Chart will be revised as required. The EA and SCP management plans will be finalized and preparation made for EA/SCP public hearings. Preparation of draft EAs will be initiated. The Regulatory Review Group will continue to provide an independent review of regulatory activities.

Institutional activities in the communications and liaison area will focus on consulting with States, Indian tribes, legislators, citizens groups, and other involved constituencies regarding field work activities. Grants will be made available to affected States and Indian tribes to support their independent review of work being conducted, to attend workshops and meetings, to facilitate exchange of information, and to provide mechanisms for negotiation with DOE on key issues.

6. Exploratory Shaft.. $ 700

The exploratory shaft conceptual design requirements will be completed using experience from the first repository and international programs. In situ test planning will be continued incorporating technology from the field testing projects at Stripa, URL, Grimsel, CSM, and Climax.

7. Test Facilities.. $ 4,700

The Heated Block Experiment at the AECL Underground Research Laboratory, (URL) will be started as well as Phase I of the Migration/Sorption Experiment. All planning for presently identified experiments will be completed. In addition, the construction of the lower test level URL will be completed and additional test planning for this location initiated.

Testing within the OECD/NEA Swedish Stripa Project will continue. A status report on test results and conclusions will be completed. Cooperation with the Swiss and French programs will involve a cooperative workshop with data exchanges between both programs continuing.

8. Land Acquisition... $ 600

Land access activities, including detailed planning required to help ensure land access for area phase investigations will be continued. Annual updates to the CRP Land Access/Acquisition Plan will be continued.

9. Project Management... $ 4,200

Activities will include contractor support in financial management and budgeting, procurement planning, administrative support services, cost/schedule planning and analysis, developing and maintaining a quality assurance program, and overall planning, coordination and management.

	FY 1986 Appropriation	FY 1987 Request	FY 1988 Estimate	FY 1989 Estimate
C. Monitored Retrievable Storage (MRS) - Total.......	$ 3,000	$46,000	$50,000	$53,000

Section 141 of the NWPA instructs the Secretary of Energy to prepare a proposal for construction of one or more MRS facilities. The NWPA states that the proposal to Congress shall include the establishment of a federal program for the siting, development, construction, and operation of such facilities; a plan for funding the construction and operation of such facilities; a plan for integrating the facilities with other storage and disposal facilities authorized in the NWPA; and site-specific designs and cost estimates. The proposal is to be accompanied by an environmental assessment. The proposal and accompanying documents are being submitted separately to the Congress.

The MRS facility is proposed to be an integral part of the federal waste management system. Its primary functions will be to receive spent fuel assemblies from commercial nuclear power plants, consolidate them (i.e., disassemble them to reduce their volume), package them in sealed canisters, and ship them to the repository for disposal. It will also provide temporary storage for up to 15,000 MTU (metric tons uranium) if required. It will receive, consolidate, and package between 2500 and 3000 MTU of spent fuel annually and be subject to full licensing by the Nuclear Regulatory Commission (NRC).

The proposed site for that facility is on the Clinch River in Tennessee approximately 25 miles west of Knoxville and adjacent to the DOE's Oak Ridge reservation. The site is within the Roane County portion of the city of Oak Ridge and is already owned and is in the custody of the Tennessee Valley Authority. It was previously planned to use this site for the Clinch River Breeder Reactor which was cancelled several years ago.

The proposed MRS facility can be operational approximately 10 years after the date of Congressional approval. Initial operation will be at a reduced rate, with operation at full rates achieved about 15 months after initial operation. The MRS facility will service the first repository, and decommissioning of the facility will be completed approximately 4 years after operations cease.

The Nuclear Waste Policy Act requires that the proposal to Congress provides for completion and operation of the MRS facility as soon as practicable following Congressional approval. This requires full funding of all activities on the critical path to facility deployment which are described in the program plan accompanying the proposal to Congress. The major near-term effort is preparation of the definitive design which is needed to prepare an application to the NRC for a license to construct the MRS. To submit the license application, the DOE must develop sufficient information on design, the expected performance and on the potential environmental effects of the facility so that the NRC can access the regulatory compliance. The license application requires a complete definitive design of those portions of the facility that are related to assurance of public health and safety. Design of other portions of the facility (i.e., the administration buildings) will continue after the license application is submitted. Several related efforts will be initiated in parallel with and to complement the final design efforts including preparation of environmental and safety analyses to support the license application. These efforts will generate information requirements as well as provide information to final design activities.

C. Monitored Retrievable Storage (MRS) - continued

Thirty (30) months are projected for the NRC review, issuance of an Environmental Impact Statement (EIS), and the granting of a license. Following receipt of the license from the NRC, the approximately 4-year construction effort for the facility will begin. After construction is completed there will be approximately 1 year of testing and demonstration before the facility becomes operational.

Also critical to the successful and timely deployment of the MRS will be the immediate establishment of an effective working relationship among the DOE, the State of Tennessee, units of local government and other Federal agencies. Funding to support these activities is also proposed.

FY 1987 Congressional Budget Request - MRS total........................ $46,000

The FY 1987 budget request is $43,000,000 greater than the FY 1986 appropriation. The increase will provide for implementation of the MRS associated activities set forth in the MRS proposal as summarized below.

The major activities and supporting funding currently envisioned as necessary in FY 1987 are as follows.

1. Design.. $14,600

   The design element involves efforts to verify and finalize the designs prepared for the MRS submission to Congress.

   The collection of new site data and verification of previously provided data will be completed. A design contractor will be selected to finalize the designs included in the MRS proposal and to incorporate the updated site-specific data gathered. Design studies will be performed to optimize process flows and determine trade offs that minimize radiological exposure and cost and ensure plant safety, reliability, maintainability and operability. Definitive designs needed for licensing, procurement, construction and operation will begin. Specific tasks include:

   - Complete site data collection;
   - Selection of the design contractor;
   - Perform design studies for selecting canister configuration interfaces, transportation cask interfaces and equipment designs, and evaluate design alternatives to minimize exposure and cost;
   - Begin detailed design drawings for licensing, procurement, construction and operation;
   - Begin feature tests for equipment to be adapted for use in the MRS;
   - Prepare test plans for specialized equipment.

2. Regulatory and Institutional.. $21,500

   The NWPA requires NRC licensing of the MRS and this will be implemented through a Regulatory Compliance Plan that will delineate the steps for obtaining the necessary permits and licenses required by Federal, State and local governments. The license from NRC will require a substantial amount of documentation including a safety analysis report, environmental analyses, studies to support the license application and to meet NEPA requirements, and a comprehensive quality assurance program.

Funding is required to support the institutional measures recommended in the proposal to Congress. This includes funding to support intergovernmental efforts agreed upon in a binding consultation and cooperation agreement between the State of Tennessee and DOE and to support financial assistance payments to the State and local governments. As discussed in the proposal to Congress, this funding will provide the State and local governments fair and reasonable financial assistance to prevent or mitigate the effects of MRS construction and operations and provide for meaningful State and local participation in developing and evaluating policies, plans and designs for the implemention of the MRS project. Funding for other activities agreed upon in the consultation and cooperation agreement between The Department and the State would also be provided.

Discussions will be initiated with the NRC to confirm the scope of environmental data and analyses needed to support the license application. In addition, discussions with State and local officials will assist DOE in scoping the issues that need more detailed evaluation. Based on these discussions, detailed analyses of field data needed to estimate the environmental impacts will begin. These data will be used in the preparation of environmental documentation that will accompany the license application to the NRC and meet DOE obligations under the National Environmental Policy Act (NEPA).

3. Systems Support and Program Management.................................... $9,900

This funding will support Headquarters and field management efforts to deploy the MRS facility in accordance with the Congressionally authorized MRS Program Plan. Necessary management activities for the timely implementation of MRS include (1) finalization of an acquisition strategy for contracts involving design, construction, and operation of the facility; (2) development of an MRS Project Management System including supporting management procedures for control, monitoring and reporting progress of program activities; (3) development and implementation of a quality assurance program consistent with DOE and NRC standards; (4) development and initiation of overall MRS systems engineering; and (5) establishment of a program planning and control activity to help maintain program schedules, measure and analyze performance.

FY 1988 Estimate.. $50,000

1. Design.. $25,000

Work will continue on the definitive design and design verification. During FY 1988, design information needed to support submission of the license application to the NRC will be completed. Testing of the Sealed Storage Casks (SSC) to be used for storage of the consolidated and canistered spent fuel will be initiated. Feature tests (tests performed to verify conceptual design choices for individual components, equipment, processes, and materials) will be completed.

2. Regulatory and Institutional.. $17,000

The Safety Analysis Report (SAR) will be completed, containing a safety assessment of the final design of all structures, systems, and components important to safety. Consultation and cooperation with the State and local governments, and other

C. Monitored Retrievable Storage (MRS) - FY 1988 Congressional Estimate - continued

communication and institutional liaison activities including financial assistance to the State and local governments will continue. Work will continue in support of the environmental documentation to support the license application and NEPA requirements that will be needed. Other activities will be to monitor and guide other program elements such as design, construction, and decommissioning, whose activities could potentially impact the environmental activities.

3. Systems Support and Program Management..................................	$8,000

The Department will continue to support contracted services for assistance in updating project planning documents, operation of project cost and schedule control systems, procurement and management of subcontractors, records management, and operation of a quality assurance program that meets NRC requirements.

FY 1989 Estimate..	$53,000
1. Design...	$29,400

Work will continue on the definitive design and design verification. SSC performance testing will be completed. The performance testing, as well as the accumulated experience with cask storage, will provide assurance of safe, reliable operations and accurate cost estimates. Development of technical specifications and planning for equipment acceptance and quality assurance testing will begin.

2. Regulatory and Institutional..	$14,900

Coordination with NRC and other regulatory agencies will continue. Activities committed to in the consultation and agreement with the State and local governments, and other communications and institutional liason activities will continue, including finanical assistance payments. The MRS license application will be submitted to NRC and docketed, including the necessary environmental documentation. This environmental documentation will discuss the potential environmental impacts (and mitigation of those impacts) resulting from construction and operation of an MRS facility at the Clinch River site.

3. Systems Support and Program Management..................................	$8,300

Management support services including contract assistance, subcontract procurements and management, project cost and schedule control, and quality assurance will continue in FY 1989.

4. Training & Testing..	$400

Planning activities for training and testing will be initiated in FY 1989. These activities are directly related to the NRC license application. Activities in this program element are designed to ensure that the MRS facility and operations staff can safely perform their intended functions at the required throughput rates and in a manner that is consistent with product quality requirement. Overall work to be undertaken in this element includes reviewing the design of MRS for operability and maintainability, preparing operations and maintenance manuals and procedures, monitoring construction, performing construction acceptance tests, preparing training manuals, training facility personnel, and conducting preoperational systems tests. The training and testing plans will be part of the NRC license application and will be reviewed by the NRC.

	FY 1986 Appropriation	FY 1987 Request	FY 1988 Estimate	FY 1989 Estimate
D. Transportation and Systems Integration - Total	$ 21,275	$33,375	$33,800	$31,050

This task provides for the continued development of transportation and integrated systems for the shipping and management of nuclear waste among the various components of the disposal system. This activity is divided into: (1) Transportation and (2) Systems Integration.

FY 1987 Congressional Request.. $33,375

1. Transportation.. $19,175

The FY 1987 budget request is $9,250,000 greater than the FY 1986 appropriation. The increase will provide for: execution of transportation cask development contracts which will also require increased support of outreach and institutional activities; implementation of the Institutional Plan issued in FY 1986; increased efforts in economic and environmental analyses required to provide route specific information for the environmental impact statement; and continued development of technology and data systems to aid in issue resolution for institutional obstacles that may impede transportation system development or generate increased costs.

The NWPA assigns DOE the responsibility to transport spent fuel and high level waste from its sources at the reactors to a repository (or to an MRS and then to a repository). The full development of a safe, efficient transport system to meet this responsibility, utilizing the private sector to the maximum extent possible, will take at least ten years. The system must have the required hardware and be set up using traffic management procedures agreeable to all parties involved. Environmental impacts and institutional issues attendant to an operating system must be carefully considered during the system design stage. Activities within this program are currently categorized into four major tasks: transportation systems acquisition; institutional programs; environmental and economic analyses; and technology development and testing support. Recognizing that an operating transportation system is dependent on successful completion of activities in each of these groups, early emphasis is being placed on activities that will require the greatest lead time to accomplish.

Early support for private sector development of new, efficient cask designs is particularly important. Existing casks are available but not of sufficient capacity or number to satisfy the estimated need. In order to have a new cask fleet available prior to 1998, cask design efforts must proceed in FY87. The increased payloads and improved handling characteristics to be derived from new designs will more than offset early expenditures for the development and demonstration of several new prototypes. Potential savings during operation lifetimes could amount to $2 billion.

Though efficiency is the primary justificaton for development of casks, safety will be the overriding design criterion. Applied development efforts that may prove desirable or necessary during the early design process will be initiated as will efforts for independent testing of scale models of designs that are being developed. Development efforts will be limited to those which have direct applicability and which have significant safety or cost savings implications. The majority of funding for FY87 will be used to complete preliminary cask design efforts initiated in late FY86, to plan for testing, and to develop needed data for cask design.

D. Transportation and Systems Integration - FY 1987 Congressional Request - continued

For planning purposes, economic assessment activities will continue as cask designs evolve. The use of dedicated trains and truck convoys will be evaluated as will the impact of transportable storage casks that may be used by utilities. The economic studies are closely tied to environmental impact studies for the first and second repositories as well as the MRS should it be approved. FY87 funding will allow updating of economic assessment as well as gathering data to support environmental impact statements. Route specific analysis will be of major importance to completion of programatic environmental impact statements.

In the institutional area, FY87 funding will support implementation of the Institutional Plan issued in FY86. A primary focus of activity will be issue resolution. Responding to NWPA direction indicating coordination with States, Tribes, and the public as well as maximum utilization of the private sector, DOE will obtain (by means of contracts) analyses and subsequent recommendations from States, Tribal, and local governments and their representative organizations as well as from other authoritative sources. The resulting analytical data base will support OCRWM in addressing institutional obstacles that threaten to greatly impede, if not preclude, spent fuel transportation and significantly increase its cost. Through this interaction, OCRWM expects to develop consensus policy positions and plans relating to route selection, emergency response, liability, mode of transportation, operational safety, cask testing, and other specific issues. A second institutional focus will be to develop the resources required to provide the interested public with generic transportation materials as well as information on OCRWM policies and programs.

2. Systems Integration.. $ 14,200

The FY 1987 budget request is $2,850,000 greater than the FY 1986 appropriation. The increase will provide for: development and conduct of prototypical demonstrations of dry rod consolidation techniques aimed at developing efficient and cost-effective waste handling and packaging equipment; and accelerated waste management systems integration activities supportive of issue resolution of interface and logistic problems between the waste generators, handling and packaging operations and repository operations.

The objective of the systems integration effort is to ensure that the possible components of a waste system, i.e., mined geologic repositories, waste generators, near-term storage, transportation and a possible MRS facility, are integrated into an efficient, safe and on-time waste management system. To achieve this objective, the systems integration effort will identify and baseline the requirements of the total system, conduct and coordinate studies to improve the system, fully assess alternative concepts, support equipment or process development and ensure compatability of the component interfaces.

System integration activities in FY 1987 will include updating and further implementation of the Systems Engineering Management Plan to develop the technical baseline for the waste management system. A System Requirements and Design Description, developed in FY 1986 to baseline the system, will be revised to reflect the current integrated waste management concept. System performance assessments will be conducted taking into account the latest cask systems, handling and storage capabilities at reactors, updated repository receipt rates and advanced packaging and handling equipment. Assessments of system cost and performance models, risk analysis

D. Transportation and Systems Integration - FY 1987 Congressional Request - continued

studies and alternative strategies will be performed and improvements made where indicated. Engineering development of various waste handling and packaging concepts will be advanced to optimize overall system performance in terms of safety, cost effectiveness and schedule. Optimization of waste packaging and handling techniques such as waste consolidation and packaging equipment could streamline many packaging and handling operations expected to occur at repository surface facilities or possible MRS facilities. Several major benefits could be realized from early consideration of means to minimize design redundancy for multiple candidate repository surface facilities and simplify licensing, construction and operations with a reduction in associated costs. Multi-purpose casks, if practical, can provide significant overall system improvements whether or not an MRS is authorized. FY 1987 efforts will also address interface and logistic problems between the waste generators, handling and packaging operations and repository operations. The results of systems analysis and testing will be provided to the Transportation and Geologic Repository Programs on an ongoing basis for incorporation into system and facility designs.

A major thrust of the FY 1987 system integration program will be developing and conducting prototypical demonstrations of dry rod consolidation techniques and developing competitively selected projects for consolidation/packaging equipment and multi-purpose canisters. The fuel rod consolidation activity will integrate the rod consolidation design efforts for the proposed geologic repositories for the purpose of developing efficient and cost-effective equipment for this process. The consolidation system design will be required to operate at specified waste acceptance rates at either a repository or MRS facility. Multiple designs will be competitively selected for further development into prototype hardware.

FY 1988 Estimate..	$33,800
1. Transportation..	$20,300

The FY 1988 funding will allow continued activities in each of the four major tasks: system acquisition, institutional programs, environmental and economic analyses, and technology development and testing support. The cask design efforts should provide final engineering designs and development of significant portions of the safety analysis reports needed for application to the Nuclear Regulatory Commission for a certificate of compliance. The designs should be adequate to allow engineering tests to be conducted independently by the DOE on scale models.

The casks being designed will be able to transport the majority of fuel and will be able to service the majority of reactors. Additional cask designs or design modifications will be needed to service the unusual facilities which may have limited access or non standard fuel. FY88 funding will allow development of these casks to begin as well as planning for even more advanced cask designs that could be employed if an MRS were introduced into the waste management system. FY88 funding will also provide for a study of how to best operate the system once the hardware is in place.

The primary focus of the environmental and economic analyses will be to continue gathering route-specific input data. Negotiations with potential carriers will begin in earnest.

D. Transportation and Systems Integration - FY 1988 Estimate - continued

FY88 institutional activity continues the initiatives of FY87. The results of the broad-based analytical effort to support issue resolution will be evaluated for incorporation in OCRWM planning documents and strategies. Production of public information resources will continue.

2. Systems Integration.. $13,500

Engineering development activities underway in FY 1987 to design and fabricate prototypical hardware for rod consolidation at a repository or MRS will continue into the test verification and operations phase. Prototypes of packaging/handling equipment will be fabricated and testing initiated.

Reactor-by-reactor waste shipment schedules will be refined. Waste form and packaging assessments will be upgraded in the area of disposal economics by incorporating the results of Title I design of the first repository, including preliminary design of the second repository. Systems integration activities will continue to assist the Office of Geologic Repositories in their waste package design and development activities. Coordination with the transportation activities will continue as economic and design data are compiled.

Interface details between handling at reactors, in transit, at interim storage facilities and at receiving, packaging and handling facilities will continue to be refined to assure safe, efficient, and economical waste systems operations. Technical and institutional issues will continue to be resolved.

FY 1989 Estimate.. $31,050

1. Transportation.. $20,050

The designs for the first fleet of casks will be nearly complete and the safety analysis reports for their designs will be submitted to the Nuclear Regulatory Commission for their review and approval. DOE will have to remain responsive during this certification process. In order to meet the aggressive schedule, long lead time items will be purchased for the cask prototypes. Testing of scale models will be conducted.

Activities related to the specialty casks and advanced concepts will continue as will the development of a request for proposal for a service contractor(s) who would be responsible for operating the transportation system. The applied development program will be supported as needed to complete designs or prepare for cask fabrication.

The environmental and economic analyses will have two major tasks upon which emphasis will be placed: (1) support for the first repository and MRS (if needed) environmental impact statements and (2) evaluation of cask designs for the least total life cycle risk and cost if they were to be incorporated into the transportation system. Heavy reliance will be placed on route-specific information.

In FY89 institutional activity among the participants in the analyis and interaction network will continue as decisions lead to issue resolution or to new approaches for addressing issues. Public information activities will expand as system definition becomes more precise and detailed.

D. Transportation and Systems Integration - FY 1989 Estimate - continued

2. Systems Integration.. $11,000

Integration studies and analyses of the waste management system will continue to support the transportation and geologic repository activities. Verification testing and performance analyses of prototype packaging/handling equipment and fuel consolidation techniques will near completion.

Interface details between reactor handling capabilities, transportation fleet cask designs, interim storage and packaging and handling facilities will be further refined to assure an optimized integrated waste management system. Waste scheduling activities will continue to be coordinated with transportation and repository facilities. Economic assessment of latest system designs and strategy options will continue to be conducted.

	FY 1986 Appropriation	FY 1987 Request	FY 1988 Estimate	FY 1989 Estimate
E. Program Management and Technical Support..................	$53,212	$69,474	$72,664	$72,192

The funding for this task provides the technical effort necessary to integrate the program and covers the costs of the Federal employees who manage the Nuclear Waste Fund. This activity is divided into: (1) Technical Support and (2) Program Management.

FY 1987 Congressional Budget Request - Program Management and Technical Support - Total.. $69,474

1. Technical Support.. $48,890

This request represents an increase of approximately $15,600,00 over FY 1986 levels. Additional funds are required for increased level of effort on technical support integration and coordination of the Civilian Radioactive Waste Management Program, defense waste studies including waste package design and development testing, and to initiate technical services to support preparation of the Environmental Impact Statement for the first repository and environmental analysis. Other increases include outreach associated with educational activities, technical support for policy issues and evaluation of waste package designs, financial assistance to national organizations, siting analysis/assessment and development and analysis of performance assessment models used by the repository projects.

This task provides for (a) technical support integration (b) fuel storage and monitoring, (c) development of standard materials characterization methods by the Material Characterization Center (MCC), (d) supporting studies including fund management activities, (e) outreach activities, (f) technical support for policy issues and program management, (g) international activities.

a) The technical support integration task provides funding for the program technical support contractor to assist OCRWM in planning and reviewing the numerous activities associated with the overall waste management disposal system. Specific contractor tasks include providing technical assistance support directly to program analysis and system engineering, total system life cycle cost studies, schedule analysis, performance modeling, cost trade-off studies, reviewing site characterization plans, assistance in implementing a state and tribe interaction program, reviewing environmental assessments, analytical support on technical policy issues and writing and reviewing safety assessments to support licensing. The contractor is also reviewing design of shafts, surface facilities, and underground excavation for a repository and assisting the DOE in coordinating the program.

b) The shipment of spent fuel at the E-MAD facility off the Nevada Test Site (NTS) to Idaho National Engineering Lab (INEL) is expected to be completed in FY 1986. FY 1987 funding is required to receive, handle and consolidate fuel assemblies from the E-MAD facility. These assemblies will be placed into storage as consolidated fuel and will be instrumented for long-term monitoring.

E. Program Management and Technical Support - FY 1987 Congressional Request - continued

c) The Materials Characterization Center (MCC) task is an integrated approach to study potential waste package materials and provides for the development of standard test procedures, reference test material, and data accumulation. DOE will continue the development of larger scale radioactive waste system tests including near-field hydrology tests that simulate realistic geologic repository environments.

d) The supporting studies include systems support, annual fee verification and calculation studies, financial audit services for the Fund, and the OCRWM component of the Nuclear Science and Engineering, Health Physics and Radioactive Waste Management Fellowship Program. The systems support is for tasks that provide technical and economic information to assist in the planning baseline for waste to be transported and received by a mined geologic disposal system. Additionally, support will be provided for the evaluation of waste package designs; the coordination of international technical information; geoscience analysis; the development and analysis of performance assessment models used by the repository projects; the development of the Environmental Impact Statement; and defense waste studies.

e) The outreach program effort involves developing publications, audiovisuals, exhibits and a plan for a national, state, regional, and local education on basic national issues.

f) Other technical support efforts include analysis of technical policy issues requiring program - wide evaluation and management support services to provide a general overview of program execution. This overview includes evaluations in program scheduling, program integration, performance evaluations, quality assurance and safety.

g) The thrust of international program efforts is to assure adequate international cooperation as well as review foreign waste policy activities, develop procedures, and provide technical participation at international meetings.

Also, included under this item are fund management activities. As stated earlier, the primary source of revenues to finance the nuclear waste disposal program is the 1.0 mill per kilowatt-hour fee charged for all commercial electricity generated by civilian nuclear powerplants beginning April 7, 1983. Another major source of revenues is anticipated from fee payments by the Department of Energy for the disposal of Defense high-level waste. The precise amounts of these fees have not been finally determined and, therefore, are not included in the revenue estimates of this request. Since the Act provides for annual review and adjustment to ensure that the revenues from the fee are sufficient to fully recover all program costs, this Office is engaged in a systematic effort, with the assistance of the Energy Information Administration, Pacific Northwest Laboratory, Oak Ridge National Laboratory, and other support contractors, to (1) gather and validate annualized life cycle cost data for each program element; (2) prepare annualized life cycle cost estimates for both reference and sensitivity cases; and (3) analyze and model total system costs and revenues to determine if the current fee is sufficient to meet the full cost recovery requirement. Progress continues to be made in refining revenue and program cost data through improved analysis methods and computer models.

Because of the high visibility of this program, OCRWM has engaged an independent accounting firm to audit the Fund on an annual basis. The auditor's primary responsibility is to attest to the fairness of financial representation of the Nuclear

E. Program Management and Technical Support - FY 1987 Congressional Request - continued

Waste Fund financial statements. The audit will be done in accordance with generally accepted auditing standards and in conformance with generally accepted accounting principles and GAO standards. The public accountant, acting independently and in a professional capacity, adds the necessary credibility to the financial statements so they may be relied upon by all interested parties.

It should be noted that the Act requires GAO to conduct an annual audit of the Nuclear Waste Fund. Also, at the request of the Senate, GAO will engage a second team of auditors to report on a quarterly basis. Further, the DOE Inspector General's staff will conduct certain audit functions independently. In each case, all auditors will exchange working papers to ensure that there is no duplication of efforts and to ensure that the Nuclear Waste Fund is operating in the most cost-effective manner.

2. Program Management.. $20,584

An increase of approximately $121,000 in this category is primarily due to other administrative support costs not identified in the base. These activities include printing and reproduction, computer maintenance, training, administrative services and materials and supplies.

The program management task covers salaries, benefits, awards, travel and contractual support services. Contractual support services include ADP data base development and training and other support services such as printing and reproduction, office space and equipment rental, postage, telecommunication, materials and supplies etc. A detailed allocation of the Program Management request follows:

	Congressional Request		
	FY 1987	FY 1988	FY 1989
Personnel Compensation	$12,756	$12,756	$12,756
Personnel Benefits	1,648	1,648	1,648
Travel and Transportation of Persons	1,416	1,473	1,528
Contractual Services	4,764	4,388	4,541
Total	$20,584	$20,265	$20,473

a. Program Mission and Functions

Section 304 of the NWPA established the Office of Civilian Radioactive Waste Management as a separate DOE organization whose Director reports directly to the Secretary. The broad mission of OCRWM is to provide for the deployment of repositories for disposal of high-level radioactive waste and spent fuel, and for the development of storage and transportation capabilities in a manner that fully protects the public health and safety. OCRWM's management organization is consistent with DOE's philosophy of decentralized management of individual projects, coupled with centralized planning and control. Accordingly, headquarters provides policy guidance, general program direction, and technical review, while project offices and contractors are responsible for the execution of projects, providing day-to-day guidance for the major contractors engaged in NWPA mission activities. Staffing for program support from other DOE Headquarters organizations is also included in this request.

E. Program Management and Technical Support - FY 1987 Congressional Request - continued

1. Headquarters: The functions of OCRWM headquarters fall into five categories of activities for which staffing is required: (1) program direction, (2) policy and outreach, (3) geologic repositories, (4) storage and transportation systems, and (5) resource management. The Office of the Director provides policy advice to the Secretary on the Civilian Radioactive Waste Management Program, and ensures that the overall direction and pace of the program proceed as required by the NWPA.

The Office of Policy and Outreach performs major staff functions related to program policy formulation, policy analysis, institutional/external relations, quality assurance and environmental standards, and international activities related to radioactive waste management.

The Office of Geologic Repositories plans, coordinates and directs the deployment of geologic repositories, including planning and scheduling, siting, repository engineering and licensing, and geoscience activities, as well as institutional interaction with the affected States and Indian tribes.

The Office of Storage and Transportation Systems manages the development of waste packaging, handling and transportation systems, interim and long-term storage facilities, including one or more potential Monitored Retrievable Storage (MRS) facilities, if authorized by Congress, and systems engineering processes.

The Office of Resource Management is responsible for Nuclear Waste Fund budget formulation and execution, accounting and auditing of resources, fee calculation and total system life cycle costing, the OCRWM Program Management System and Program Management Information System, other management information systems, the Project Decision Schedule, management of contracts with waste activities for disposal of high-level radioactive waste, and traditional support activities, including procurement, personnel, and correspondence and records management.

2. Field

OCRWM project offices at Richland, Washington; Las Vegas, Nevada; Columbus, Ohio; and Chicago, Illinois are responsible for geologic repository activities in the basalt, tuff, and salt and crystalline rock media, respectively. Among the responsibilities of OCRWM project offices are consultation and coordination with State governments, Indian tribes and the public on repository issues, preparation of environmental assessments, site investigation and characterization, and repository license application support. In addition, the Richland Operations Office and Idaho Operations Office provide support in MRS and transportation systems design and development, and rod consolidation equipment development and demonstration.

b. FY 1987 Congressional Request

A total of 292 full time equivalents (FTEs) in FY 1987 is requested for Federal positions at headquarters and in the field directly associated with the technical management of the activities related to geologic repositories, Monitored Retrievable Storage, transportation, waste systems integration, and management of the Nuclear Waste Fund. Although in creased workloads will result from implementation of the geologic repository subprogram's detailed site characterization phase, MRS proposal follow-on activities with Congress and affected parties for three sites, and field studies in crystalline rock for the siting of the second repository, no additional FTE's above the FY 1986 level are requested. This request includes employee development activities to provide incentives and training to retain qualified staff and managers for the long-term radioactive waste management effort.

The allocation of FTEs by function and location is as follows:

	FY 1986 Appropriation	FY 1987 Request	FY 1988 Estimate	FY 1989 Estimate
Program Direction (HQ)	4	4	4	4
Policy and Outreach (HQ)	18	18	18	18
Geologic Repositories				
Headquarters	48	48	48	48
Field	136	136	136	136
Storage and Transportation Systems				
Headquarters	21	21	21	21
Field	9	9	9	9
Resource Management (HQ)	36	36	36	36
Program Support (HQ)	20	20	20	20
TOTALS	292	292	292	292

FY 1988 Estimate - Program Management and Support - Total.. $72,664

1. Technical Support.. $52,399

In FY 1988, technical support contractor assistance will continue with emphasis on the preparation of site recommendation documentation. Efforts will also continue in long-term fuel storage monitoring. The Materials Characterization Center will continue to support integration of waste package materials testing and will focus on accumulated data from field tests during site characterization and data obtained from foreign programs. These data will be the basis for the license application as related to the waste form release rate and the metal waste container life expectancy. The large scale radioactive waste systems test would continue. These tests would add considerably to the credibility of the data base and would provide the necessary extrapolation of repository performance spanning thousands of years. Evaluation of waste package designs and test programs would continue. Performance assessment scientific support to the respository development effort would also continue incorporating site-specific design information and the development of performance codes. In addition, support will continue to be provided to the development of an Environmental Impact Statement and for defense waste studies. Supporting studies and fund management activities will continue at essentially the same levels as FY 1987 as will outreach activities, technical support for policy issues and program management, and coordination of international activities.

E. Program Management and Technical Support - FY 1988 Congressional Estimate - continued

2. Program Management.. $20,265

The total staffing is estimated to be 292 FTEs in FY 1988 to manage intensified site characterization work and exploratory shaft construction management, increased interaction with interested parties in regard to first and second repository deployment, and preparation of repository and waste systems licensing documents.

FY 1989 Estimate - Program Management and Technical Support - Total.. $72,192

1. Technical Support.. $51,719

Technical support work will continue in FY 1989. The technical support contractor will continue to provide technical expertise in areas of systems engineering, waste package development, performance assessment, and technology tradeoff and cost analysis. Long-term fuel storage and monitoring will also continue. Efforts will continue at MCC on materials development, integration and performance in a repository environment. Performance assessment scientific support and evaluation of waste package designs will also continue as will support for development of an Environmental Impact Statement and defense waste studies. Supporting studies and fund management activities will continue at FY 1988 levels of effort as will outreach activities, technical support for policy issues and program management and international support.

2. Program Management.. $20,473

The total staffing is estimated to be 292 FTEs in FY 1989. No increase is anticipated over FY 1988 levels.

F. Debt Service (Interest)

This budget item identifies the actual interest expense of the Nuclear Waste Fund. DOE repayed the appropriated debt of approximately $264,964,393 in FY 1985. This has resulted in the elimination of interest expense (debt service) after FY 1985.

DEPARTMENT OF ENERGY
FY 1987 CONGRESSIONAL BUDGET REQUEST
OPERATING EXPENSE FUNDED PROJECT DATA SHEET
NUCLEAR WASTE FUND

Nuclear Waste Fund Construction
Nuclear Waste Fund

(Tabular dollars in thousands. Narrative material in whole dollars.)

Exploratory Shaft at Hanford, Washington
Richland Operations Office

Total Estimated Cost (TEC) $140,700,000
(For Design and Construction)

Exploratory Shaft at Hanford, Washington
Richland Operations Office

Total Estimated Cost (TEC) $140,700,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	Cumulative Prior Years	FY 1985 Actual			FY 1986 Estimate	
	Obs.	B/A	Obs.	B/O	B/A	B/O
Operating expenses (DOE):						
Design and construction (TEC)	$20,724	$ 1,332	$ 1,332	$ 1,664	$11,946	$10,318
Management and integration:						
M&I (Non-TEC)	5,859	1,276	1,276	1,598	1,500	1,500
M&I (TEC)	2,997	2,086	2,086	2,086	2,000	2,000
Subtotal - M&I	8,856	3,362	3,362	3,684	3,500	3,500
Operations	208	216	216	200	200	200
Testing	3,481	4,295	4,295	4,131	5,070	4,000
Decommissioning	---	---	---	---	---	---
Total operating expenses	$33,269	$ 9,205	$ 9,205	$ 9,679	$20,716	$18,018
Capital equipment:						
CE (Non-TEC)	96	251	251	36	856	289
CE (TEC)	1,893	2,549	2,549	3,649	28	28
Subtotal - CE	1,989	2,800	2,800	3,685	884	317
Other DOE funding	595	---	---	---	---	---
Total Project funding	$35,853	$12,005	$12,005	$13,364	$21,600	$18,335
Total - (Non-TEC)	($10,239)	($ 6,038)	($ 6,038)	($ 5,965)	($ 7,626)	($ 5,989)
Total - (TEC)	($25,614)	($ 5,967)	($ 5,967)	($ 7,399)	($13,974)	($12,346)

Exploratory Shaft at Hanford, Washington
Richland Operations Office

Total Estimated Cost (TEC) $140,700,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1987 Estimate		FY 1988 Estimate		FY 1989 Estimate	
	B/A	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):						
Design and construction (TEC)	$33,978	$28,519	$30,690	$34,342	$ 6,606	$10,732
Management and integration:						
M&I (Non-TEC)	1,500	1,500	3,430	3,283	481	1,607
M&I (TEC)	2,000	2,000	7,741	7,741	4,660	4,660
Subtotal - M&I	3,500	3,500	11,171	11,024	5,141	6,267
Operations	200	200	13,270	12,502	19,127	18,475
Testing	9,151	7,712	11,778	11,998	9,393	9,652
Decommissioning	---	---	---	---	---	---
Total operating expenses	$46,829	$39,931	$66,909	$69,866	$40,267	$45,126
Capital equipment:						
CE (Non-TEC)	791	1,504	127	117	---	175
CE (TEC)	3,266	2,791	48	523	---	---
Subtotal - CE	4,057	4,295	175	640	---	175
Other DOE funding	---	---	---	---	---	---
Total Project funding	$50,886	$44,226	$67,084	$70,506	$40,267	$45,301
Total - (Non-TEC)	($11,642)	($10,916)	($28,605)	($27,900)	($29,001)	($29,909)
Total - (TEC)	($39,244)	($33,310)	($38,479)	($42,606)	($11,266)	($15,392)

Exploratory Shaft at Hanford, Washington
Richland Operations Office

Total Estimated Cost (TEC) $140,700,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1990 Estimate		FY 1991 Estimate		Total Cost
	B/A	B/O	B/A	B/O	B/A
Operating expenses (DOE):					
Design and construction (TEC)	---	$ 953	---	---	$105,276[a]
Management and integration:					
M&I (Non-TEC)	$ 7,346	5,803	$ 893	$ 1,888	22,285
M&I (TEC)	6,121	6,121	35	35	27,640[a]
Subtotal - M&I	13,467	11,924	928	1,923	49,925
Operations	29,599	28,802	11,593	13,842	74,413
Testing	18,312	20,024	4,406	5,152	65,886
Decommissioning	---	---	---	---	---
Total operating expenses	$61,378	$61,703	$16,927	$20,917	$295,500
Capital equipment:					
CE (Non-TEC)	---	---	---	---	2,121
CE (TEC)	---	---	---	---	7,784[a]
Subtotal - CE	---	---	---	---	9,905
Other DOE costs	---	---	---	---	595
Total Project costs	$61,378	$61,703	$16,927	$20,917	$306,000
Total - (Non-TEC)	($55,257)	($54,629)	($16,892)	($20,882)	($165,300)
Total - (TEC)	($ 6,121)	($ 7,074)	($ 35)	($ 35)	($140,700)

[a] To reconcile with the TEC $140,700,000, add $27,640,000 of Management and Integration, and $7,784,000 of Capital Equipment to Design and Construction $105,276,000.

Exploratory Shaft at Hanford, Washington
Richland Operations Office

Total Estimated Cost (TEC) $140,700,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

Description, Objective and Justification

The Exploratory Shaft (ES) facility is located at the Reference Repository Location (RRL) approximately 1 mile (1.6 kilometers) west of the boundary for the 200 West Area on the Hanford Site near Richland, Washington. The facility will consist of two six-foot inside diameter blind-drilled shafts with grouted steel liners. When completed, the two shafts will be capable of transporting personnel and materials to the proposed horizon (Cohassett). The underground drifts will allow for in situ characterization of the site. The ES site will encompass approximately 45 acres (18 hectares) of surface area enclosed within an 8-foot antipersonnel fence.

Design and construction of the ES facility is being performed in two distinct stages, ES Phase I (first shaft activities), and ES Phase II (second shaft activities).

Phase I will consist of a borehole approximately 110-inches (279 centimeters) in diameter, lined with a 6-foot (1.8 meters) ID Steel liner, capable of transporting personnel and materials to the proposed depth of approximately 3,160 feet to provide access to the reference repository horizon. Shaft breakout will verify the performance of the grout seal to safely isolate the reference horizon from the Hanford ground water systems. Sump pumps, electrical service, ventilation air, and compressed air will be provided at depth.

Phase II will be an addendum to the existing ES Phase I site and will consist of a second shaft, approximately 110-inches (279 centimeters) in diameter lined with a 6-foot (1.8 meters) ID steel liner, and expanded surface and underground workings. The shaft station will be expanded to about 1,600-feet of drifts containing service areas and test chambers. Prime factors dictating construction of the second shaft are to provide personnel working underground a second means of ingress/egress, and allow for reversible ventilation throughout the facility.

ES Phase II objective - conduct in situ testing to obtain information necessary for repository design, performance assessment, the Draft Environmental Impact Statement (DEIS), and the License Application (LA).

The in situ testing program will assess the geologic characteristics and hydrologic properties of the candidate repository horizon to aid in evaluation of the isolation capability of the RRL, and to assess geomechanical characteristics to determine if the stability of openings can be maintained throughout the operational life of the proposed repository without adversely affecting isolation capability or retrievability.

Description, Objective and Justification (Continued)

If the ES facility is not used as a component of the repository, detailed plans for normal decommissiong will include dismantling of the surface facilities and utilities, shaft sealing, and the return of the site to its natural state. All structures, i.e., mobile offices, storage facilities, electrical distribution equipment, explosive magazines, etc., will be removed for reuse or salvage. Drilling fluid, which can be reused, will be removed. The mud pits will be dried to the depth of the bentonite lining and filled. Shafts and tunnels will be backfilled from the spoil piles. The surface will be blended or tilled and the area graded to blend with adjacent contours. Reseeding may be provided. No costs have been budgeted for this element.

If the ES Project becomes a part of an operating repository, then a portion of the repository Safety Analysis Report (SAR) will be dedicated to ES decommissioning.

Capital equipment related to construction consists of shaft hoists (both main hoist and stand-by hoist) emergency generator, ventilation equipment, such as fans and compressors, cooling towers, colling water pumps, transformers and major switchgear. Capital equipment for test programs will be limited to items located at the surface since test assemblies taken underground will be subjected to an adverse environment, which will render them unusable by the conclusion of the test program.

The technical management of the ES Program is under the direction of Rockwell Hanford Operations (Rockwell) in support of the Department of Energy-Richland Operations Office (DOE-RL). Facility design, both surface and subsurface, is being performed by Raymond Kaiser Engineers, Inc./Parsons Brinckerhoff Quade & Douglas, Inc.(RKE/PB), joint venture Architect/Engineer (A/E) under contract to DOE-RL. The construction of the ES facility will be performed by Morrison-Knudsen, Co., Inc. (M-K), Construction Manager (CM), under contract to DOE-RL. Rockwell has been designated as technical manager of both the A/E and the CM. Specification, design, installation, and conduct of the test program is the responsibility of Rockwell. Results of the ES test program will be integrated into the Draft Environmental Impact Statement (DEIS) and License Application, which are documents to be prepared by Rockwell. These documents, along with results from other Basalt Waste Isolation Project (BWIP) site characterization activities, will form the basis for a seleaction of the first repository site. Specialized support for the ES Program is furnished by other Hanford site subcontractors, and other DOE-RL contractors.

Description, and Objective and Justification (Continued)

Operation of the ES Facility will be conducted on a 7-day per week, 24-hour per day basis. Upon completion of underground construction and acceptance of the facility by the operating contractor, operators on the surface will operate and maintain life support systems to support the underground test programs. The life support systems will consist of the shaft's main and emergency hoists, electrical power, compressed air, ventilation air, service water, lighting, communication systems, and emergency systems.

The Underground Test Plan defines the testing required for in situ characterization. This Test Plan is designed to fulfill the following overall ES Program objectives:

ES Phase I objective - provide access to the preferred candidate repository horizon to perform in situ testing.

The overall objectives of the ES Program are as follows: (1) to provide access to the preferred candidate repository horizon to perform in situ testing; and (2) conduct in situ testing to obtain information necessary for repository design, performance assessment, the Draft Environmental Impact Statement, and the License Application.

Surface evaluation of the Reference Repository Location in basalt does not provide data at a sufficient level of confidence necessary for site characterization. The ES Program will contribute to site characterization through extensive in situ testing. This testing will assess the geologic characteristics and characteristic variables; assess the hydrologic properties to aid in evaluation of the isolation capability of the candidate basalt horizon; and determine that the stability of openings can be maintained throughout the operational life of the proposed repository without adversely affecting isolation capability or retrievability. At the conclusion of the ES Program, and throughout the use of data obtained in other BWIP site characterization activities, data will be available to assess the suitability of the basalt on the Hanford site for use as a nuclear waste repository.

Exploratory Shaft at Hanford, Washington
Richland Operations Office

Total Estimated Cost (TEC) $140,700,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(a) Schedule of Planned Activities

The following table represents the total program broken down by summary tasks:

Activity	Calendar Year			
	Start		Complete	
Complete ES Phase I Conceptual Design			July	1981
Issue Phase I Test Plan			September	1981
ES Phase I Long Lead Procurement	December	1981	December	1984
ES Phase II Title II Design Report Approved and Released	February	1982	September	1983
Complete Principal Borehole Testing	January	1982	January	1983
Issue Revised Draft Exploratory Shaft Test Program	April	1982	December	1984
Second Shaft Conceptual Design	June	1984	April	1985
Complete Construction Prerequisite Readiness Review for First Shaft	October	1984	March	1987
Prepare Second Shaft Definitive Design	April	1986	June	1987
Construct First Exploratory Shaft	May	1987	November	1988
Construct Second Exploratory Shaft	April	1988	September	1989
Porthole Testing First Shaft	December	1988	April	1989
Breakout and Mine Shaft Station	April	1989	June	1989
ES Phase I Testing	April	1989	June	1989
Mine Main Drifts, Hydrology Drift, and Rock Mechanics Drift	June	1989	February	1990
Perform Exploratory Shaft In Situ Test Program	July	1989	May	1991

Total Estimated Cost (TEC) $140,700,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(b) Management and Contracting

The technical management of the ES facility design, construction, operation, and testing is under the direction of Rockwell in support of the DOE-RL. Surface and subsurface facility design is being performed by RKE/PB, a joint venture A/E under direct contract to DOE-RL. Exploratory Shaft facility construction will be performed by M-K, Construction Manager, under direct contract to DOE-RL. Test design, procurement, installation, and performance is the responsibility of Rockwell. Specialized support, such as design and construction of offsite facilities, is furnished by the Hanford A/E (Kaiser Engineering Hanford Company) and the Hanford Project Construction firm (J.A. Jones Construction Services Company) under the direction of Rockwell.

(c) Prior Year Achievements

Both the water line from 200 West to the ES Phase I site, and the electrical powerline/substation were completed and accepted for operation. Long-lead procurement for big hole drill tools, main hoist, drill pipe, 112-inch shaft liner, and 72-inch shaft liner, was completed by Rockwell. Other significant achievements include: Phase I Title II design completion; mobilization of the CM; completion of the drill pad and collar; and mobilization of the big hole drill rig. Subsequent to mobilization of the drill rig a program directive was received, in February 1983, which mandated suspension of drilling pending future authorization. The drill rig has been maintained in a secured stand-by mode pending restart.

A revised draft of the Underground Test Plan (containing upgraded objectives and tests for the ES Phase I and Phase II in situ test program) was submitted to DOE-RL for review and comment in September 1983. Subsequently, a Test Plan Workshop consisting of members of the RL-BWIP Overview Committee, the Nuclear Regulatory Commission (NRC), the U. S. Geological Survey (USGS), and other concerned parties was convened in Richland, Washington during November 1983 to solicit peer review and comments on the adequacy of the Test Plan. In conjunction with the preceding activities, the ES Phase II Functional Design Criteria (FDC) were revised to include provision for a second 6-foot diameter shaft. The FDC together with a proposed Statement of Work for A/E services were submitted to DOE-RL for approval in October 1983.

The porthole drill and associated equipment have been procured, set-up in the Near Surface Test Facility (NSTF), and porthole drilling out of a simulated 6-foot shaft, has been successfully demonstrated. A drill for drilling long horizontal boreholes (approximately 1,000 feet) was procured, set-up at the NSTF, and drilling demonstrated successfully.

Exploratory Shaft at Hanford, Washington
Richland Operations Office

Total Estimated Cost (TEC) $140,700,000

(Tabular dollars in thousands. Narrative material in whole dollars)

(d) Current Year Achievements

Complete construction and installation of the underground utilities to all office trailers. Complete Phase I procurement of 72-inch (1.8 meters) diameter liner sections. Maintain drill rig in secured standby mode. This update reflects a delay in start of deep hole drilling to May, 1987 and breakout at the Cohassett flow horizon.

Complete conceptual design for the Phase II facility. Initiate definitive design changes as required on Phase II liners, starter hole, and drill pad and collar design packages to support start of construction in 1988. Resolution of all comments resulting from the November 1983 Test Plan Workshop, and release of the Underground Test Plan in December 1984. Continue test design and preparation of test procedures for the ES Phase II in situ test program.

(e) Reasons for Increases and Decreases

The current year budget, dated January 1985, identified a Total Estimated Cost (TEC) of $165,200,000. The decrease in the TEC shown in this submission is due mainly to the better definition of the Exploratory Shaft design and its associated cost estimate. It also reflects the current schedule for in start of drilling; drill rig buy out costs; increased emphasis on construction and pre-operational readiness review; and escalation.

(Tabular dollars in thousands. Narrative material in whole dollars.)

(f) Cost Estimate

Design and construction costs are based on a planned start-of-drilling by May 1986 for Phase I, and April 1988 for Phase II. The estimate includes costs for the purchase of the drill rig, service agreement for the maintenance of the rig, by a major drilling sub-contractor and stand-by mode costs.

The ES Total Estimated Cost is based upon actuals incurred through fiscal year 1985, and estimated costs from fiscal year 1986 through fiscal year 1991. Construction costs estimates are based on definitive design for Phase I and conceptual design for Phase II.

	Item Cost	Total Cost
1. Engineering, design and inspection		$ 8,631
2. Construction costs		111,975
(a) Site Preparation	$ 1,725	
(b) Surface Facilities	4,105	
(c) First Shaft	37,462	
(d) Second Shaft	22,294	
(e) Subsurface Excavations	7,930	
(f) Underground Service Systems	13,640	
(g) Construction Management	24,819	
Subtotal		120,606
3. Contingency		20,094
Total Estimated Cost		$140,700

An overall contingency rate of approximately 17 percent is a result of application of contingency rates appropriate to each remaining work element.

Escalation rates are applied to all fiscal years in accordance with Department of Energy validated indices for the Richland Operations Office area.

DEPARTMENT OF ENERGY
FY 1987 CONGRESSIONAL BUDGET REQUEST
OPERATING EXPENSE FUNDED PROJECT DATA SHEET
NUCLEAR WASTE FUND

Nuclear Waste Fund Construction
Nuclear Waste Fund

(Tabular dollars in thousands. Narrative material in whole dollars.)

Exploratory Shaft at Yucca Mountain, NTS
Nevada Operations Office

Total Estimated Cost (TEC) $34,711,000
(For Design and Construction)

Exploratory Shaft at Yucca Mountain, NTS
Nevada Operations Office

Total Estimated Cost (TEC) $34,711,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	Cumulative Prior Years	FY 1985 Actual			FY 1986 Estimate	
	Obs.	B/A	Obs.	B/O	B/A	B/O
Operating expenses (DOE):						
Design and construction (TEC)	$ 4,717	$ 829	$ 829	$ 829	$ 872	$ 872
Management and integration:						
M&I (Non-TEC)	3,114	1,074	1,074	1,074	3,036	3,036
M&I (TEC)	---	---	---	---	147	147
Subtotal - M&I	$ 3,114	1,074	1,074	1,074	3,183	3,183
Operations	462	---	---	---	---	---
Testing	1,370	4,808	4,808	4,716	8,036	8,099
Decommissioning	---	---	---	---	---	---
Total operating expenses	$ 9,663	$6,711	$6,711	$6,619	$12,091	$12,154
Capital equipment	6,345	1,785	1,785	1,350	1,789	2,019
Other DOE funding	---	---	---	---	---	---
Total Project funding	$16,008	$8,496	$8,496	$7,969	$13,880	$14,173
Total - (Non-TEC)	($11,291)	($7,667)	($7,667)	($7,140)	($12,861)	($13,154)
Total - (TEC)	($ 4,717)	($ 829)	($ 829)	($ 829)	($ 1,019)	($ 1,019)

Exploratory Shaft in Yucca Mountain, NTS
Nevada Operations Office

Total Estimated Cost (TEC) $ 34,711,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1987 Estimate		FY 1988 Estimate		FY 1989 Estimate	
	B/A	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):						
Design and construction (TEC)	$14,329	$12,941	$11,210	$12,598	---	---
Management and integration:						
M&I (Non-TEC)	2,841	2,841	2,937	2,937	3,523	3,523
M&I (TEC)	925	925	1,682	1,682	---	---
Subtotal - M&I	3,766	3,766	4,619	4,619	3,523	3,523
Operations	2,823	2,823	6,009	6,009	3,873	3,873
Testing	17,437	14,912	24,473	24,473	21,974	21,974
Decommissioning	---	---	---	---	---	---
Total operating expenses	$38,355	$34,442	$46,311	$47,699	$29,370	$29,370
Capital equipment	2,737	3,552	1,261	1,261	453	453
Other DOE funding	---	---	---	---	---	---
Total Project funding	$41,092	$37,994	$47,572	$48,960	$29,823	$29,823
Total - (Non-TEC)	($25,838)	($24,128)	($34,680)	($34,680)	($29,823)	($29,823)
Total - (TEC)	($15,254)	($13,866)	($12,892)	($14,280)	(---)	(---)

Exploratory Shaft at Yucca Mountain, NTS
Nevada Operations Office

Total Estimated Cost (TEC) $34,711,000[a]

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1990 Estimate		FY 1991 Estimate		Total Cost
	B/A	B/O	B/A	B/O	B/A
Operating expenses (DOE):					
Design and construction (TEC)	___	---	---	---	$ 31,957[a]
Management and integration:					
M&I (Non-TEC)	$1,760	$ 1,760	$1,703	$1,703	19,988
M&I (TEC)	---	---	---	---	2,754[a]
Subtotal - M&I	1,760	1,760	1,703	1,703	22,742
Operations	2,072	2,072	994	994	16,233
Testing	18,350	20,875	4,627	4,656	101,075
Decommissioning	----	----	----	---	---
Total operating expenses	$22,182	$24,707	$7,324	$7,353	$172,007
Capital equipment	271	271	142	1,842	14,783
Other DOE costs	----	----	----	----	------
Total Project costs	$22,453	$24,978	$7,466	$9,195	$186,790
Total - (Non-TEC)	($22,453)	($24,978)	($7,466)	($9,195)	($152,079)
Total - (TEC)	(---)	(---)	(---)	(---)	($ 34,711)

[a] To reconcile with the TEC of $34,711,000, add $2,754,000 of Management and Integration to Design and Construction $31,957,000.

Exploratory Shaft at Yucca Mountain, NTS
Nevada Operations Office

Total Estimated Cost (TEC) $34,711,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

Description, Objective and Justification

This project will provide a 1,480-foot deep, 12-foot finished, inside diameter, concrete-lined, vertical shaft and a 1,200-foot deep, 6-foot inside diameter, vertical shaft with associated surface facilities, subsurface lateral excavations, and subsurface lateral borings. A wide range of geologic, geochemical, geomechanical, hydrologic and thermal testing, and data acquisition activities to be conducted in the shaft complex are included in the project. A description of the project in terms of major elements of engineering and construction activities are provided below:

Improve 7 miles of dirt road to include grading and widening to 22 feet and applying a double oil and chip surface treatment; construct about 6 miles of 69 kV overhead electrical power transmission line and about 6 miles of 6-inch diameter underground water line, including two 120 horsepower (hp) booster pumping stations.

Grade and stabilize an approximate 5-acre contiguous site surface areas to include drainage provisions and access control fencing.

Install a 5,000 kVA electrical substation with one 69 kV/4160V primary transformer, switchgear and circuit breakers, and 4160/480/240V secondary transformers and distribution systems; provide a 1,000 kVA emergency electrical generator system; and install a 100,000-gallon water storage-distribution system at the shaft site.

Construct concrete building foundations, trailer pads and mine plant equipment pads, and erect four pre-engineered metal buildings (60-by 50-foot hoist house, 20 by 20 emergency hoist house, 40- by 30-foot warehouse and 40- by 30-foot shop); set and connect 12 60- by 12-foot trailers; install one 900 hp and one 400 hp mine hoist, and one 100 hp emergency mine hoist, two 100 hp ventilation fans and two 1,500 cfm air compressors. Total project costs include funds for capital equipment purchases necessary for the operation of tests and for the facility design and construction that will require such items as hoists, generators, compressors, transformer, etc.

Construct a 12-foot finished, inside diameter by 40-foot deep reinforced shaft collar including reinforced concrete headframe foundation and install dual sheave 80-foot high mine headframe; construct a 14-foot diameter 1,480-foot deep shaft by conventional mining techniques, lined with unreinforced concrete to a finished inside diameter of 12 feet; and fitted with horizontal steel sets on a 10-foot spacing, personnel ladderway, conveyance guides, communication cable, electrical conduit, water and compressed air lines; install permanent shaft conveyances to include a double deck personnel cage and bottom dump muck skip; and install a mine dewatering system.

Description, Objective and Justification (Continued)

Drill a 12-1/4-inch diameter vertical pilot hole from the surface to a depth of 1,200-feet to intersect a lateral drift which extends approximately 260 feet from the centerline of the 12-foot diameter shaft. Raise bore a 7- to 8-foot diameter shaft through the pilot hole and install a 6-foot inside diameter liner. Install a temporary headframe and emergency personnel hoisting system at the collar of the 6-foot finished diameter raise bored shaft.

Excavate and provide ground support for underground openings in the main test level (1,200-foot depth), upper test level (520-foot depth), and shaft bottom (1,480-foot depth) equivalent to about 1,500-linear feet of 15- by 15-foot tunnel. Provide miscellaneous excavations and borings necessary for the installation of the in situ test hardware.

Management and integration activities consist of project planning and scheduling, budgeting, technical direction and control. Review, integrate, and approve engineering designs to assure compatibility with project technical requirements. Develop and implement project safety and quality assurance plans and procedures. Provide project support from the architect-engineer and the construction manager as required.

The operating contractor will provide metered electric power, communications, first-aid/ambulance service, and operating personnel to sustain the day-to-day operation of the Exploratory Shaft Facility (ESF) and to maintain underground access for user personnel. Provide inspection and maintenance services for all ESF equipment, facilities and systems. Provide labor for direct support of underground testing program. Provide safety training and certification, for personnel responsible for operational control of underground access.

Testing activities will include geologic and hydrologic observations and geologic, hydrologic, geochemical, thermal and mechanincal tests. Acquire, store and analyze test data by means of the integrated data acquisition and control system (IDS). Prepare technical reports to be used in determining the suitability of the Yucca Mountain site for the construction of a high-level nuclear waste repository.

If the site is determined to be unsuitable for a repository, plans for decommissioning the ESF will be developed and implemented in accordance with the requirements contained in the NWPA. Presently, no specific criteria has been developed to estimate cost for decommissioning planning and implementation, therefore, no costs are included in the total project costs for this element.

Description, Objective and Justification (Continued)

The primary objective of this project is to obtain and analyze in situ geotechnical data to be used in determining the suitability of the Yucca Mountain site for the construction of a high-level radioactive waste repository. Functional requirements of the design, construction, and operations phases which support the primary objective are to (1) provide access to selected underground tuff horizons and surrounding strata in an unsaturated zone at the Yucca Mountain site, and (2) provide the ability to safely and effectively acquire the necessary data for testing.

The NWPA requires that the DOE conduct site characterization activities at candidate repository sites to evaluate the suitability of such sites for the construction of a high-level radioactive waste repository. The Yucca Mountain site is among three potentially acceptable candidate sites which are scheduled to be approved to proceed with the exploratory shaft construction phase of site characterization.

Exploratory Shaft at Yucca Mountain, NTS
Nevada Operations Office

Total Estimated Cost (TEC) $34,711,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(a) Schedule of Planned Activities

The following table presents the total program broken down by primary tasks:

Activity	Calendar Year: Start		Calendar Year: Complete	
Conceptual Design[a]	April	1981	June	1982
Test Plan Development[a]	February	1982	March	1986
Title I Engineering[a]	October	1982	January	1983
Road and Utilities Extensions[a]	July	1982	May	1983
Title II Engineering[a]	December	1982	September	1983
Long-lead Procurement[a]	February	1983	February	1984
Design and Specification (IDS)	January	1984	May	1985
Design Summary Document	July	1984	April	1985
Design for Raise Bore Shaft	July	1984	June	1985
Shaft Contractor Procurement	December	1985	July	1986
Site Preparation	December	1986	May	1987
Shaft Sinking (12-foot diameter)	May	1987	September	1988
ESF Testing	May	1987	May	1991
Underground Mining	October	1988	January	1989
Raise Bore 6-foot Diameter Shaft	September	1988	April	1989
Lateral Core Hole Drilling	December	1988	July	1989

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[a] Activity Completed (For Single Shaft Concept)

(b) Management and Contracting

This project is managed by the DOE Nevada Operations Office (NV) through its Waste Management Project Office (WMPO). The Director, WMPO, is the Project Manager for the Exploratory Shaft project. The Project Manager receives project specific technical planning and direction assistance from the ES Conceptual Design Report, the ES Functional Design Criteria, and the Underground Test Plan. A Project Management Plan, NVO-255, dated August 1983, has been developed in accordance with DOE Order 5700.4 to provide the basic guidance and describe the organizational structure and procedures for the conduct of the ES project.

The Nevada Operations Office NV the procurement agent responsible for acquiring the necessary services to accomplish the design, construction, and testing for the ES. The basic procurement strategy for the ES design and construction phases is to utilize three existing NV operating contracts with major subcontracts for services, materials, and equipment to be competitively awarded. The current plan is to accomplish the construction of the two shafts and horizontal drifts through a fixed price contract awarded to and managed by REECO. The budget authority in FY 1987 is sufficient to authorize work on construction of the first shaft. The budget authority for construction of the second shaft and horizontal drifts is provided in FY 1988. The three existing NV contracts are cost-plus-award-fee contracts identified as follows:

(1) Contract No. DE-AC08-84NV10322, Fenix and Scission, Inc. (F&S), Architect-Engineer for drilling and mining.
(2) Contract No. DE-AC08-76NV00020, Holmes & Narver, Inc. (H&N), Architect-Engineer for surface facilities.
(3) Contract No. DE-AC08-84NV10327, Reynolds Electrical and Engineering Co., Inc. (REECO), Operating Support and Construction Contractor.

In addition to the technical planning and direction provided by the University of California (LANL), scientific services of the Lawrence Livermore and Sandia National Laboratories and the U.S. Geological Survey are provided for testing and data analyses. Technical and management support is provided by Science Applications, Inc., under Contract No. DE-AC08-83NV10270.

Exploratory Shaft at Yucca Mountain, NTS
Nevada Operations Office

Total Estimates Cost (TEC) $34,711,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(c) Prior Year Achievements

All long-lead construction-related equipment were received. A conceptual design report for the Integrated Data Acquisition System (IDS) was completed. Revision of Title II drawings to incorporate the second shaft have been completed. An NRC/DOE exploratory shaft design and construction workshop was conducted.

(d) Current Year Achievements

The Exploratory Shaft Test Plan (ESTP) draft will be completed and delivered to DOE for review and revision prior to submittal to the Nuclear Regulatory Commission. An NRC/DOE workshop on the ESTP will be conducted. The shaft construction subcontract will be awarded. Field and laboratory test activities related to test execution planning and test equipment design will continue.

(e) Reasons for Increases and Decreases

The current year budget, dated January 1985, identified a Total Estimated Cost (TEC) of $44,741,000 in Year Of Expenditure (YOE) dollars. The decrease in the TEC shown in this submission is due mainly to the redefining of the work breakdown structure. Test support costs expected to be incurred during construction were formerly allocated to construction WBS elements. These costs are now allocated to the testing WBS element.

The current year budget (FY 1986) identified a total project cost in year-of-expenditure dollars of $164,000,000 comprised of $154,000,000 in operating expenses and $10,000,000 in capital equipment. The reason for the increase from $164,000,000 to $187,000,000 is due mainly to redefining the work breakdown structure which center a more realistic basis to develop estimates for management and integration, testing, and capital equipment requirements. The $23,000,000 increase is comprised of $18,000,000 of operating costs and $5,000,000 of capital equipment costs.

Total Estimated Cost (TEC) $34,711,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(f) Cost Estimate

The cost estimate has been developed based upon the current baseline work breakdown structure (WBS) for the Exploratory Shaft. Level 2 WBS elements are shown below.

	Item Cost	Total Cost
1. Engineering, design, and inspection		$ 3,715
2. Construction costs		27,722
(a) Site preparation	$ 6,185	
(b) Surface Facilities	637	
(c) First Shaft	10,480	
(d) Second Shaft	1,459	
(e) Subsurface Excavations	2,750	
(f) Underground Service Systems	3,457	
(g) Construction Management	2,754	
Subtotal		31,437
3. Contingency		3,274
Total Estimated Cost		$34,711 ======

The figures include contingency ranges from 10 percent to 25 percent applied to level 2 WBS elements consistent with the uncertainties associated with defining and controlling each level 2 WBS element. The primary sources of the basic cost figures are: 1) engineering estimates of February 1985 for surface and subsurface facilities based upon revised design;

(f) Cost Estimate (Continued)

2) operating contractor estimates of February 1985 for maintenance and operations; 3) principal investigator's estimates of March 1985 for the preparation of final technical reports associated with the Exploratory Shaft project through the second quarter of FY 1991; and 4) conceptual design estimates of February 1985 for the Integrated Data System (IDS).

Escalation rates are applied to all fiscal years in accordance with indices established for construction projects by the Department of Energy.

DEPARTMENT OF ENERGY
1987 CONGRESSIONAL BUDGET REQUEST
OPERATING EXPENSE FUNDED PROJECT DATA SHEET
NUCLEAR WASTE FUND

Nuclear Waste Fund Construction

(Tabular dollars in thousands. Narrative material in whole dollars.)

Exploratory Shaft in Salt
Chicago Operations Office

Total Estimated Cost (TEC) $177,218,000
(For Design and Construction)

Exploratory Shaft in Salt
Chicago Operations Office

Total Estimated Cost (TEC) $177,218,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	Cumulative Prior Year	FY 1985 Actual			FY 1986 Estimate	
	Obs.	B/A	Obs.	B/O	B/A	B/O
Operating expenses (DOE):						
Design and construction (TEC)	$ 4,801	$ 603	$ 603	$ 1,621	$ 2,656	$ 4,163
D&C Second Half of Liner	---	---	---	---	---	---
Subtotal - D&C	4,801	603	603	1,621	2,656	4,163
Management and Integration:						
M&I (Non-TEC)	4,513	681	681	918	933	936
M&I (TEC)	5,367	646	646	3,624	6,437	5,087
Subtotal - M&I	9,880	1,327	1,327	4,542	7,370	6,023
Operations	---	104	104	---	728	763
Testing	2,169	917	917	1,343	3,145	2,885
Decommissioning	---	---	---	---	---	---
Total Operating Expenses	16,850	2,951	2,951	7,506	13,899	13,834
Capital equipment:						
CE (Non-TEC)	---	---	---	---	---	---
CE (TEC)	---	---	---	---	---	---
Subtotal - CE	---	---	---	---	---	---
Other DOE funding	---	---	---	---	---	---
Total Project funding	$16,850	$2,951	$2,951	$7,506	$13,899	$13,834
Total - (Non-TEC)	($ 6,682)	($1,702)	($1,702)	($2,261)	($4,806)	($4,584)
Total - (TEC)	($10,168)	($1,249)	($1,249)	($5,245)	($9,093)	($9,250)

Exploratory Shaft in Salt
Chicago Operations Office

Total Estimated Cost (TEC) $177,218,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1987 Estimate		FY 1988 Estimate		FY 1989 Estimate	
	B/A	B/O	B/A	B/O	B/A	B/O
Operating expenses (DOE):						
Design and construction (TEC)	$20,598	$18,793	$56,080	$45,838	$22,159	$36,056
D&C Second Half of Liner	---	---	---	---	23,521	23,521
Subtotal - D&C	$20,598	$18,793	56,080	45,838	45,680	59,577
Management and integration:						
M&I (Non-TEC)	861	911	495	490	498	494
M&I (TEC)	5,217	4,930	6,634	6,399	3,832	4,868
Subtotal - M&I	6,078	5,841	7,129	6,889	4,330	5,362
Operations	555	548	584	575	5,066	2,707
Testing	6,303	5,513	11,610	10,893	15,576	16,004
Decommissioning	---	---	---	---	---	---
Total operating expenses	$33,534	$30,695	$75,403	$64,195	$70,652	$83,650
Capital equipment:						
CE (Non-TEC)	1,397	800	268	597	---	268
CE (TEC)	6,585	5,155	259	1,689	146	146
Subtotal - CE	7,982	5,955	527	2,286	146	414
Other DOE funding	---	---	---	---	---	---
Total Project funding	$41,516	$36,650	$75,930	$66,481	$70,798	$84,064
Total - (Non-TEC)	($ 9,116)	($ 7,772)	($12,957)	($12,555)	($21,140)	($19,473)
Total - (TEC)	($32,400)	($28,878)	($62,973)	($53,926)	($49,658)	($64,591)

Exploratory Shaft in Salt
Chicago Operations Office

Total Estimated Cost (TEC) $177,218,000[a]

(Tabular dollars in thousands. Narrative material in whole dollars.)

	FY 1990 Estimate		FY 1991 Estimate		Total Costs
	B/A	B/O	B/A	B/O	
Operating expenses (DOE):					
Design and construction (TEC)	$ 9,332	$ 9,758	---	---	116,229[a]
D&C Second Half of Liner	---	---	---	---	23,521[b]
Subtotal - D&C	9,332	9,758	---	--	139,750(a)
Management and integration:					
M&I (Non-TEC)	619	614	$ 605	$ 683	9,205
M&I (TEC)	2,127	2,201	218	249	30,478[a]
Subtotal - M&I	2,746	2,815	823	932	39,683
Operations	13,562	12,833	9,349	12,522	29,948
Testing	14,269	14,764	11,344	12,618	65,333
Decommissioning	---	---	---	---	----
Total operating expenses	$39,909	$40,170	$21,516	$26,072	$274,714
Capital equipmment:					
CE (Non-TEC)	---	---	---	---	1,665
CE (TEC)	---	---	---	---	6,990[a]
Subtotal - CE	---	---	---	---	8,655
Other DOE costs	---	---	---	---	----
Total Project costs	$39,909	$40,170	$21,516	$26,072	$283,369
Total - (Non-TEC)	($28,450)	($28,211)	($21,298)	($25,823)	($106,151)
Total - (TEC)	($11,459)	($11,959)	($ 218)	($ 249)	($177,218)

[a] To reconcile with the TEC $177,218,000, add $30,478,000 of Management and Integration, and $6,990,000 of Capital Equipment to Design and Construction $139,750,000.

[b] Costs for the second half of the liners includes the associated CM and Title III costs.

Exploratory Shaft in Salt
Chicago Operations Office

Total Estimated Cost (TEC) $177,218,000

Tabular dollars in thousands. Narrative material in whole dollars.)

Description, Objective and Justification

All engineering and construction activities related to site preparation, surface buildings, shaft sinking, subsurface excavation, and underground service systems are covered by this task. The surface facilities will occupy approximately 50 acres plus transportation and utility access. Two shafts will be sunk using conventional drill and blast techniques and will be finished to a 12-foot diameter and be to a depth ranging from 2,100 to 3,300 feet depending on the basin selected.

When completed, the ESF in salt will consist of the two shafts and supporting surface facilities including headframes, hoist houses, offices, warehouse, and a dry building. The prime factors dictating construction of the second shaft are ventilation and ingress/egress underground. To be in full compliance with Mine Safety and Health Administration (MSHA) regulations and DOE Order 5480.1A a second shaft is required for gassy mine conditions (30 CFR 57) and two means of ingress and egress from the underground. Shaft hoisting facilities will be designed to meet the requirements of the program.

Designing, constructing, and operating the ESF include organizational activities of DOE, the Office of Nuclear Waste Isolation (ONWI), and the following three participants: an architect/engineer (A/E) to design the facility; a construction manager (CM) to manage the construction activities; and an operations contractor (presently included in the CM contract) to operate the facility. Operational services will be provided to the DOE (SRPO) by the CM as necessary. These services include electric power, communications, ventilation, lighting and emergency systems. The A/E has developed preliminary designs for two 12-foot shafts. Final design and Title III activities will follow. The CM is contractually and technically responsible to DOE. ONWI will provide DOE with technical integration support services for the CM's effort. Scope of the CM operations will include providing personnel for the operations, maintenance, and security of the ESF and other services defined by SRPO.

The maximum subsurface area available for underground testing through using two 12-foot diameter shafts depends on the underground in situ temperature and the temperature of incoming air both of which vary widely among sites. In any event, the subsurface area will have a minimum of 5,000 linear feet of openings. This will provide for limited flexibility to accommodate changes in the in situ test program. Key testing activities consist of preparing and finalizing a site-specific Underground Test Plan, completing specifications to procure and install a data acquisition system, preparing and finalizing the shaft instrumentation plan to be implemented during shaft excavation, and preparing detailed test plans for performing tests from the ESF.

Total Estimated Cost (TEC) $177,218,000

(Tabular dollars in thousands of dollars. Narrative material in whole dollars.)

Description, Objective and Justification (Continued)

If the site is determined to be unsuitable for a repository the ESF will be decommissioned in accordance with the requirements of Public Law 97-425. No costs have been budgeted for this element.

The objective of the Exploratory Shaft Facility is to provide access to a selected salt horizon for detailed in situ characterization to acquire data necessary to support a license application to the Nuclear Regulatory Commission (NRC) for construction and operation of a nuclear waste repository, including:

- Verification of the repository design parameters. This includes the constitutive relationship, heat transfer characteristics, thermal loading response, and rheological behavior of salt.
- Evaluation of the isotropy and homogeneity of the salt at the repository horizon.
- Demonstration of the constructability and confirmation of the design to gain access to the repository horizon.
- Demonstration that the stability of openings can be maintained throughout the operational life of the proposed repository without adversely affecting isolation capability or retrievability.

Total Estimated Cost (TEC) $177,218,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

Public Law 97-425 requires that the DOE conduct site characterization activities including construction of the ESF followed by at depth testing, at candidate repository sites to evaluate the suitability of such sites for the construction of a high-level radioactive waste repository.

(a) Schedule of Planned Activities

Major exploratory shaft program activities are:

	Calendar Year			
Activity	Start		Complete	
Preliminary Design	December	1984	January	1986
Detailed Design	April	1986	June	1987
Long Lead Procurement	July	1986	TBD	
Construction:				
Site Preparation	June	1987	TBD	
Surface Facilities Construction	July	1987	TBD	
Support Systems and Operating Support	July	1987	September	1990
First Shaft Construction	November	1987	May	1989
Second Shaft Construction	November	1987	May	1989
Subsurface Facilities	May	1989	November	1989
Startup/Operations:				
Site Suitability Testing	August	1989	November	1990

Total Estimated Cost (TEC) $177,218,000

Tabular dollars in thousands. Narrative material in whole dollars.)

(b) Management and Contracting

Plans to successfully design, construct, and operate the ESF include organizational activities of DOE, the Office of Nuclear Waste Isolation (ONWI), and the following three participants: an architect/engineer (A/E) to design the facility; a construction manager (CM) to manage the construction activities; and an operations contractor (presently included in the CM contract) to operate the facility. The A/E will develop preliminary designs for two 12-foot shafts, develop final designs, provide Title III services, and prepare a set of final as-built drawings. The CM is contractually and technically responsible to DOE. ONWI will provide DOE with technical integration support services for the CM's effort. Scope of the CM operations will include providing personnel for the operations, maintenance, and security of the ESF. The current plan is to accomplish the mining of the two shafts and horizontal drifts through a fixed-price contract awarded to and managed by the CM. The budget authority in FY 1987 is sufficient to authorize work on the first phase of this mining contract, which involves preparation of the site and installation of the shaft collar down to the 100-foot level. The budget authority for the remaining phases of the work under the mining contract is provided in FY 1988, FY 1989 and FY 1990.

(c) Prior Year Achievements

Contracts were awarded to the A/E, and the integrating contractor. They and their subcontractors are organized to proceed with the critical activities to support the ESF construction start. A preliminary design for one drill shaft was completed.

The necessary support in the development of the Environmental Assessments for seven candidate sites was provided. A comprehensive study on a ESF two shaft facility and recommended shaft diameters was prepared for DOE headquarters. A comprehensive permitting strategy was developed, and a variety of technical support activities were also performed.

(d) Current Year Achievements

Complete final revisions of the two shaft preliminary designs for the three candidate sites along with an A/E cost estimate and preliminary design reports. The final design on the site recommended to the President will begin. Permitting and statutory compliance activities on the recommended site will begin, and procurement of ESF hoists will be initiated.

Support will be provided for the preparation of the site characterization plan, and underground testing plans will continue to be developed.

(e) Reasons for Increases or Decreases

The current year budget, dated January 1985, identified a Total Estimated Cost (TEC) of $210,255,000. The decrease in the TEC shown in this submission is due mainly to the better definition of the Exploratory Shaft design and its associated cost estimate. It also reflects the current schedule for start of construction; revision of cost estimates to better reflect the current project strategy; the identification and modification to the scope for operations during construction. Additionally, the impact of criteria changes from the Title I design review process were projected and included. Other adjustments were made in accordance with the guidance provided in "the definition and treatment of engineering, design, and inspection costs" prepared by the Engineering Design and Inspection Steering Committee of DOE, dated August 23, 1985.

Total Estimated Cost (TEC) $177,218,000

(Tabular dollars in thousands. Narrative material in whole dollars.)

(f) Cost Estimate

	Item Cost	Total Cost
1. Engineering, design and inspection		$ 14,252
2. Construction costs		129,602
(a) Site preparation	$ 7,171	
(b) Surface facilities	1,713	
(c) First shaft	30,535	
(d) Second shaft	32,083	
(e) Subsurface excavation	6,887	
(f) Construction management	24,154	
(g) Capital equipment	6,990	
(h) Operations	20,069	
Subtotal		143,854
3. Contingency		33,364[a]
(a) Contingency on construction costs	9,843	
(b) Second half of liner	23,521	
Total Estimated Cost		$177,218

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[a] Contingency is estimated at approximately 10 percent of construction plus capital equipment costs, and costs for the second half of the liner and associated CM and Title III costs. Escalation rates are applied to all fiscal years in accordance with indices established for construction projects by the Department of Energy.

DEPARTMENT OF ENERGY
FY 1987 CONGRESSIONAL BUDGET REQUEST
CONSTRUCTION PROJECT DATA SHEETS

Nuclear Waste Fund - Plant and Capital Equipment
Nuclear Waste Fund
Office of Civilian Radioactive Waste Management
(Tabular dollars in thousands. Narrative material in whole dollars.)

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1. Title and location of project: Monitored retrievable storage facility, Clinch River Site, Tennessee

2. Project No.: 87-W-101

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3. Date A-E work initiated: 2nd Quarter FY 1987

3a. Date physical construction starts: 3rd Quarter 1991

4. Date construction ends: 2nd Quarter 1996

5. Previous cost estimate: None.

6. Current cost estimate: $1,104,200[a]
Less amount for PE&D: --

Net cost estimate: $1,104,200[a]
Date: 9/85

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7. Financial Schedule:

Fiscal Year	Authorization	Appropriation	Obligations	Costs
1987	$ 7,200	$ 7,200	$ 7,200	$ 2,200
1988	22,600	22,600	22,600	19,900
1989	29,800	29,800	29,800	30,900
1990	32,700	32,700	32,700	26,200
1991	91,200	91,200	91,200	52,100
1992	224,000	224,000	224,000	208,400
1993	275,500	275,500	275,500	271,200
1994	264,700	264,700	264,700	288,300
1995	148,300	148,300	148,300	194,100
1996	8,200	8,200	8,200	10,900

[a] Includes escalation at the rates given in the attached Table A.1, Appendix A.

1. Title and location of project: Monitored retrievable storage facility,
Clinch River Site, Tennessee

2. Project No.: 87-W-101

8. Brief Physical Description of Project:

The Monitored Retrievable Storage (MRS) facility will be designed to include all facilities and equipment to receive, unload, disassemble and consolidate, canister and ship to a geologic repository or to temporarily store onsite for subsequent shipment to a geologic repository, commercial spent fuel from nuclear reactors. The facility will be designed to receive and handle 3,000 metric tons of uranium (MTU) per year as spent fuel. It will also be designed to store and ship the hardware resulting from consolidation of the spent fuel assemblies and other radioactive materials from operation of the facility. An in-building lag storage capacity for 1,000 MTU of spent fuel in canisters is provided. An outdoor storage capacity of up to 15,000 MTU of spent fuel will be provided. Total possession limit of spent fuel on the site at any one time is 15,000 MTU.

The MRS facility, being an independent installation, will require facilities to support the spent-fuel processing and storage operations. These include administrative, maintenance, warehousing, security, fire-protection, and standby power generation facilities.

Improvements to Land

Improvements to land will include paved access roads and staff parking lots, railroad spur lines, service areas, and sidewalks. All portions of the site disturbed by construction will be stabilized to prevent,soil erosion. Modest landscaping will include energy-conserving, low maintenance plantings.

Buildings

o Receiving and Handling (R&H) Building

The R&H building is the primary operating building of the MRS facility. It will be designed to physically contain and control all radioactive materials received and processed or generated by the spent-fuel process operations. The building includes spaces and equipment for receiving, identifying, disassembling, consolidating, and packaging of spent fuel and processing and packaging of spent-fuel hardware for onsite storage or retrieving from storage and shipping offsite for disposal. The building will contain a lag storage vault for 1,000 MTU of consolidated spent-fuel in canisters.

Designated areas of the R&H building are used for: administration, receiving and inspection, remote handling, including spent-fuel consolidation and packaging (hot cells), 1,000 MTU lag storage, transfer/discharge, radwaste processing, and building services.

The administration area contains offices for management, staff, and operations functions; changerooms; and serves as the control point for personnel entry into the R&H building.

CONSTRUCTION PROJECT DATA SHEETS

1. Title and location of project: Monitored retrievable storage facility, Clinch River Site, Tennessee

2. Project No.: 87-W-101

8. Brief Physical Description of Project: (continued)

Two identical receiving and inspection areas are provided to serve the process cells and offsite shipping functions. Each receiving and inspection area includes an incoming air-control vestibule that includes vehicle washdown capabilities, a cask receiving and inspection area, and a vehicle exit air-control vestibule. Each is sized for two rail/truck lanes and contains a 150-ton-capacity bridge crane for shipping cask unloading and loading. The receiving and inspection areas are fully equipped to routinely receive and process casks of spent fuel. The equipment in these areas is designed to wash road grime from railcars or trucks and protective covers of shipping casks; and to prepare casks for unloading from railcars or trucks onto cask transfer carts. Shipping casks enter and exit the shipping loadout rooms from the receiving and inspection area on electrically powered cask carts traveling on rails.

The remote handling area includes cask handling and decontamination rooms, cask unloading rooms, spent-fuel shielded process cells, lag storage compartments, spent-fuel cask loadout rooms, shipping loadout rooms, and maintenance cells for cell equipment and cell cranes. The remote handling areas are fully equipped to routinely receive and process casks of spent fuel. The equipment in these areas is designed to perform inspection, identification, disassembly, consolidation, and canistering of spent fuel; to compact nonfuel-bearing components generated by the disassembly of spent fuel; and to perform remote maintenance and contact-handled maintenance of equipment. For personnel access to the shielded hot cells, air-control vestibules and health physics storage rooms with keyed doors are provided. Operating galleries around the shielded process cells provide operators with visual control of process operations, and allow use of master/slave manipulators, wall-mounted traveling electromechanical manipulators, and operating consoles for control to remote cell operations.

In the transfer/discharge areas, crawler-type transporters enter and exit the R&H building with the sealed storage cask.

The radwaste process areas are designed to contain the equipment used to treat, for recycling or storage, radioactive liquid and solid waste generated onsite as a consequence of processing spent fuels. Radioactive waste treatment capabilities include volume reduction, solidification, and storage of radioactive wastes generated at the MRS facility. Separate treatment systems are provided for low-level waste (LLW) and/or LLW/contact handled Transuranic (CHTRU) wastes and high-activity waste (HAW) and/or HAW/RHTRU wastes. The LLW wastes are stored temporarily onsite and shipped to an offsite LLW disposal facility. The CHTRU, HAW, and HAW/RHTRU are stored onsite and will be shipped offsite to a selected NRC licensed facility.

The building service areas contain such functions as the analytical laboratory, control room, health physics facility, laundry room, manipulator maintenance and storage, and mechanical and electrical equipment spaces. The analytical laboratory is designed to contain equipment, chemical materials, and supplies necessary for the analyses of radioactivity of samples of the solids, liquids, and gases taken from the various locations or processes in the MRS facility.

1. Title and location of project: Monitored retrievable storage facility
Clinch River Site, Tennessee

2. Project No.: 87-W-101

8. Brief Physical Description of Project: (continued)

The control room is designed to contain control consoles and CCTV monitors for supervisory control and monitoring of operations in the process cells; for monitoring and control of HVAC, utilities, and radwaste systems; and for monitoring of radioactive airborne particulates. A redundant system is located in the Site Services building control room (one of the support facilities) as a backup in case of failure or sabotage of the control room equipment in the R&H building.

A health physics facility is included for the purpose of monitoring personnel for radioactive contamination and for decontamination when necessary.

Building services area spaces are also provided for air supply and exhaust equipment, air-filtration systems, comfort heating and cooling equipment, uninterruptible power supply (UPS) and electrical equipment, laundry equipment, manipulator storage and maintenance, telephone equipment, and storage.

Systems that support the various operations in the R&H building have been provided and include decontamination solution preparation and distribution, radwaste drain system, washdown water system, steam generation system, welding station cleaning and testing system, deionized water system, vacuum air sampling system, water softener system, and laundry and dry cleaning system for contaminated clothing.

Electrical power service, distribution, grounding, lighting, communications, and alarm systems have been provided for the R&H building.

Building electrical power is obtained from normal primary feeder configuration systems. For each substation, either normal substation, either normal feeder is rated to carry 100% of the substation load. If failure of one of the primary feeders occurs, power is switched to the second feeder automatically with minimum delay in transfer time. If simultaneous failure of both normal primary feeders occurs, power is provided by four primary feeders from the standby generator system. Standby power is provided to the UPS battery chargers, selective lighting, and other critical operation systems. The standby power system is provided to permit safe and orderly shutdown of the facility if there is a total failure of the normal power supply sources. An uninterruptible (battery) power supply (UPS) system is provided for neutron criticality monitoring and alarms, radionuclide monitoring and alarms, air monitoring and sampling systems, fire alarms and supervision circuits, security surveillance system, access control, radio communications, and distributed control instrumentation system.

The facility is provided with a fire alarm and detection system, public address system, intercom system between the control room and process cell consoles, telephone system, exterior door access control and alarm system, wireless radio paging for selected personnel, building visual and audible alarm systems, and closed-circuit television system.

1. Title and location of project: Monitored retrievable storage facility, Clinch River Site, Tennessee

2. Project No.: 87-W-101

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8. Brief Physical Description of Project: (continued)

The instrumentation and controls for the R&H building provide for: (1) safe and efficient operation of handling and processing equipment throughout the entire facility; (2) safe shutdown integrity; (3) reliability, redundancy, modularization, and standardization, with components and subassemblies capable of being removed for inspection, maintenance, or replacement; (4) remote operation, when required; and (5) transmission of information to remote locations.

Automatic monitoring, alarming, and surveying instrumentation, is designed and used to detect and warn personnel of high radiation levels in controlled work areas.

Controls for mechanized and automated remote handling and processing equipment allow the equipment to be controlled locally, from gallery-located supervisory control panels, or centrally from the control room.

Heating, ventilating, and air-conditioning (HVAC) systems are designed to maintain the required temperatures, and ventilation- and confinement-control environments within the R&H building. Temperatures are controlled as required for the processes performed in the area served, and for the efficient performance of the operating personnel.

In the R&H building, the ventilation and confinement control provides the essential part of the final and internal confinement systems, and acts as a barrier to minimize the spread of radioactive contamination.

Nonprocess areas are protected by automatic wet-pipe sprinkler systems; critical areas, such as the control room and electrical equipment room, are provided with Halon 1301 systems.

o Support Facilities

Support facilities are provided to maintain a self-sufficient MRS facility. These include the following buildings.

Administration building - The administration building is designed to accommodate such functions as accountability, plant management, plant operations, finance and administration, health and safety, quality assurance, personnel, and public relations. To house these functions, the building has offices, a conference room, a computer room a lunchroom, a multipurpose room, storage rooms, a mail room, restrooms, and building equipment rooms. Dedicated office space has been provided for management, regulatory, and oversight personnel.

CONSTRUCTION PROJECT DATA SHEETS

1. Title and location of project: Monitored retrievable storage facility, Clinch River Site, Tennessee

2. Project No.: 87-W-101

8. Brief Physical Description of Project: (continued)

Security-related buildings - Site security functions are housed in various buildings in strategic locations on the MRS facility site. The purpose of these facilities is to prevent unauthorized access, prevent removal of items of security interest, and provide physical protection and access controls to deter attempts at sabotage or theft. The security-related buildings are described below.

Security building - The Security building serves as security headquarters and provides facilities for the safeguards and security systems. It provides for the security personnel, with their administrative offices, and support facilities, as well as the Alarm Monitoring Station (AMS) and the radio communication system. The building has a lobby/waiting area, offices, multipurpose room, showers, restrooms, exercise room, building equipment rooms, and a hardened, bullet-resistant area that houses the MRS site secondary AMS. As part of the building, a security patrol vehicle parking enclosure, with three parking spaces, is provided.

Main Gate/Badgehouse - The Main Gate/Badgehouse is located at the main entrance, and is designed to serve as the initial observation and inspection point for all nonwaste transport vehicles entering the site, as well as security clearance and badge control for all visitors and employees. The building has a badge/clearance processing room, guardroom, passage room, waiting room, vestibules, restrooms, and equipment room.

Inspection Gatehouse - The Inspection Gatehouse provides for initial observation, inspection, and entrance clearance for all rail and transport vehicles delivering radioactive shipments to the facility. The building has a guard/inspector room, a restroom, and a storage room.

Protected Area Gatehouse - The Protected Area Gatehouse is located at the entrance to the MRS facility protected area. It serves as a badge checkpoint for monitoring and inspecting all employees entering and leaving the protected area. It has an inspection area for nontransport vehicles, such as delivery vehicles, maintenance vehicles, or any other vehicle authorized to enter the protected area. The building has an access control room, detection monitoring room, mechanical and electrical equipment rooms, and a hardened area containing the primary control alarm and remote surveillance room with its associated UPS system. This gatehouse is equipped with a hardened, primary AMS system; detection devices for metal, explosives, and radiation; and an x-ray inspection unit.

CONSTRUCTION PROJECT DATA SHEETS

1. Title and location of project: Monitored retrievable storage facility, Clinch River Site, Tennessee

2. Project No.: 87-W-101

8. Brief Physical Description of Project: (continued)

Site Services building - The Site Services building is a multifunction building. It provides shops for nonradioactive maintenance and fabrication, a process cell mockup area, offices for shop management, and other support areas. The shops included are machine, millwright, pipefitting, welding, sheetmetal, carpentry, plastics/glass/ceramic, electrical, instrument, paint, and a steam-cleaning area. The office area includes offices for shop management, physical plant operations personnel, and engineering personnel. Support functions include warehousing, mail, and reproduction. It also includes a computer room, a lunchroom, training and conference rooms, locker rooms, restrooms, and mechanical equipment rooms. This building also contains a control room for the redundant MRS centralized process and utility monitoring control and alarm system (DCS), which acts as a backup for that contained in the R&H building. Parking is provided adjacent to the building for onsite service vehicles.

Warehouse - The Warehouse serves as the main storage location in support of operations for the MRS support facilities. It is located near the Site Services building, and is provided with both truck and rail access. Besides the large warehouse area, the building has a waiting area, receiving room, restrooms, and an electrical equipment room.

Vehicle Maintenance building - The Vehicle Maintenance building provides routine maintenance and service for all vehicles dedicated for use at the MRS facility. A service station is located adjacent to the building. This building contains a locker room, restroom, lunchroom, railcar service area, semi-truck repair area, onsite vehicle overhaul and lubrication bays, paint shop, and supporting electrical and mechanical rooms.

Fire Station - The Fire Station provides complete facilities to house firefighting equipment, a paramedical ambulance personnel and equipment, fire-protection personnel (full-time and on-call), and limited combined cooking, dining, exercise, and training facilities. The building is divided into three major functional areas: (1) firefighting apparatus and equipment; (2) personnel facilities; and (3) building services. The building contains a lunchroom, nurse's station with an examination room, offices, restrooms, fire alarm and dispatch center, main apparatus room, breathing air cylinder and fire extinguisher charging rooms, and electrical and mechanical equipment rooms.

Standby Generator building - The Standby Generator building contains the equipment that provides electrical power upon loss of normal power. The building contains five main generator rooms; a sixth room houses all electrical switchgear. The Standby Generator building is a reinforced concrete structure, designed to withstand earthquakes and tornadoes.

CONSTRUCTION PROJECT DATA SHEETS

1. Title and location of project: Monitored retrievable storage facility, Clinch River site, Tennessee

2. Project No.: 87-W-101

8. Brief Physical Description of Project: (continued)

Steam Generator building - The Steam Generator building contains the steam boilers and associated equipment for the process and heating requirements of the R&H building.

Other Structures

Other structures to be constructed at the MRS facility include the CHTRU storage facility and the spent fuel and HAW/RHTRU storage facilities.

o CHTRU Storage Facility

The CHTRU storage facility is designed to provide storage for CHTRU wastes generated onsite while processing the first 15,000 MTU of spent fuel. The waste stored in this facility arrives in drums from the solid low-level radwaste treating and packaging system in the R&H building.

The facility is designed as an underground box structure. Each storage compartment is equipped with provisions for manually sampling the air and monitoring the interior for temperature and radiation level. The temperatures of the multidrum enclosures are measured manually by means of access ports through the roof plug. Air samples are also taken at these same ports, and are analyzed at the analytical laboratory in the R&H building.

The facility contains a gravity-drain system which conveys any liquids from the compartments to two main drain sumps. Each sump is provided with a fixed beta and gamma radiation monitor and a level meter for monitoring the sump liquid. Both of these variables are indicated, recorded, and alarmed by the DCS in the R&H building. If required, collected liquid is removed by vacuum truck.

o Spent Fuel HAW/RHTRU Storage Facilities

The spent fuel and HAW/RHTRU storage facilities are designed to store radioactive waste processed through the R&H building. The storage concept uses an array of sealed storage casks (concrete casks) containing the canisters of spent fuel stored in an open field above ground. The concrete cask and steel liner are designed for radiation shielding and to remove the heat by convection and thermal radiation.

CONSTRUCTION PROJECT DATA SHEETS

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1. Title and location of project: Monitored retrievable storage facility, Clinch River Site, Tennessee

2. Project No.: 87-W-101

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8. Brief Physical Description of Project: (continued)

The concrete storage casks provide a sealed, dry storage container which also shields for intact spent-fuel assembly canisters, consolidated fuel rod canisters, drums of nonfuel-bearing components, and drums and canisters of RHTRU and high-activity waste. The storage casks are cylindrical, reinforced concrete structures with a stepped, carbon-steel-lined cavity for storing waste canisters and drums. A cylindrical concrete shield plug fits into the open top of the cavity and a steel cover plate is seal-welded to the liner flange to close the cask. For purposes of conceptual design, all casks have been designed with the same height and exterior configuration. The casks are 22-ft. high by 12-ft. dia. (outside diameter). The cask and the enclosed canisters provide double containment for spent fuel and will withstand credible natural phenomena and man-induced events.

Monitoring of the concrete cask liner and cover integrity is performed on a periodic basis. Sampling of a cask internal atmosphere is performed by removing an access cover bolted to the gas sampling port housing. An evacuated bottle with a valve is attached to the quick-disconnect fitting on the end of the assembly of compression fittings located inside the port housing. Gas samples are collected for analysis to determine the presence of any gaseous fission products or canister tag gas in the cask interior. Results obtained from cask samples indicate whether canisters or canisters and fuel rods have lost their integrity. Cask liner/cover integrity is tested by using a pressure-decay check.

Monitoring will also include temperature surveillance of the casks. Temperature measurement is accomplished by using thermocouples installed in tubes, extending from the cask exterior to the liners of spent fuel and related waste casks. The thermocouple/tube design allows for replacement operations in the storage facility if failure occurs.

Special Facilities

The hot cell equipment is specifically designed to disassemble and consolidate spent fuel assemblies and to seal the consolidated fuel rods within a steel canister. Equipment is provided to inspect the welds and decontaminate the canisters. Remotely-controlled cranes and transfer carts are provided to move spent fuel assemblies and canisters.

The sealed storage cask is transferred from the cask manufacturing area to the R&H building and from the building to the storage facility on a crawler-type transporter. Once in the storage facility, the cask is lifted from the transporter by engaging a special lifting fixture from the emplacement crane and setting the cask on a previously prepared concrete pad.

CONSTRUCTION PROJECT DATA SHEETS

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1. Title and location of project: Monitored retrievable storage facility, Clinch River Site, Tennessee

2. Project No.: 87-W-101

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8. Brief Physical Description of Project: (continued)

Utilities

Utilities such as water, sanitary sewer, process waste sewer, electrical power distribution and fuel oil distribution systems are provided for the MRS facility.

Water from an offsite source will be piped to the MRS facility storage tank and distributed to all of the facilities onsite.

The MRS facility sanitary sewer system collects and treats domestic sewage. The system consists of a central sewage treatment plant and a collection system that collects raw sanitary sewage from uncontaminated areas of the R&H building and from the support buildings.

Process waste generated in the MRS facility that is not contaminated, but contains chemical constitutents harmful to the function of the sanitary sewage treatment system, is collected and treated by the process sewer system. The sewers lines drain to a lift sump, where the process sewage is neutralized as necessary and pumped to the process sewage treatment plant for clarification and filtration to remove the suspended solids and undesirable chemical constitutents before disposal. The dewatered sludge is disposed of at an appropriate waste site, depending upon the chemical content of the sludge.

Normal electrical power is provided by independent transmission lines. The transmission lines terminate at the MRS facility main substation in an outdoor switchyard. The high voltage power is transformed to 5-kV and distributed to the various buildings. Standby power is generated onsite by diesel-engine-driven generators. Four generators are provided -- each capable of supplying one-third of the maximum standby load. Standby power is supplied to the critical equipment by automatic switchover equipment in the event both sources of normal power fail.

Fuel oil is provided at the facility. The fuel oil distribution systems supply the hot water boilers, steam boilers, and standby power generators. Fuel oil storage is above ground with the capacity equivalent to the supply needed for 45 calendar days of operation.

Standard Equipment

Standard equipment will consist of office, lunchroom, conference room, etc., furnishings, and all analytical equipment and furnishings in the laboratories. Also included with this item is the shop equipment in the site services and vehicle maintenance buildings. All site vehicles and utility equipment such as mobile, rubber-tired cranes, garbage trucks, fire engines, etc., will be provided as part of the project.

1. Title and location of project: Monitored retrievable storage facility, Clinch River Site, Tennessee

2. Project No.: 87-W-101

8. Brief Physical Description of Project: (continued)

Major Computer Items

Major computer control systems are provided in the R&H building. The distributed control system monitors, alarms, and controls all process and utility systems within the R&H building. There are local operator control stations and the primary station is located in the control room of the building.

Another major computer system is the programmable logic controller for the process and canyon cell equipment. From the local work station, the operations of the in-cell equipment can be monitored and manually controlled as needed. The system has data storage and retrieval capability as well as graphics generation for the work stations.

9. Purpose, Justification of Need for, and Scope of Project:

The purpose of this project is to provide a facility for the monitored retrievable storage of spent nuclear fuel resulting from operation of the nation's civilian nuclear power plants. This request is prepared in conjunction with the submittal of a proposal to Congress for construction of an MRS facility in response to Section 141 of the Nuclear Waste Policy Act of 1982 (the Act or NWPA).

Having completed an environmental assessment, the conceptual designs, the need and feasibility study, and an evaluation of programmatic options, the DOE has concluded that an MRS facility located at the Clinch River site and designed to be an integral component of the waste management system could significantly improve the performance of the system. This conclusion was also influenced by the experience of the past three years in implementing the provisions of the Act and the resultant understanding of the managerial, regulatory, and institutional complexities of the waste management system.

The most significant advantages of an integral MRS facility are as follows:

1. Improvements in the reliability and flexibility of operations of the waste management system. These improvements would be realized by separating the acceptance of spent fuel from reactors from its emplacement in the repository. Furthermore, by being able to prepare waste for disposal, the MRS facility would allow the DOE to separate a major part of the waste management process (acceptance, transportation from the reactor sites, consolidation, and sealing in canisters) from uncertainties about the repository and to proceed immediately with detailed planning for, and implementation of, that part. The storage facility will obviate the need for planning and providing some additional at-reactor storage. Storage costs avoided range from $150,000,000 to $1,700,000 000, in 1985 dollars, depending upon the scenario considred.

CONSTRUCTION PROJECT DATA SHEETS

1. Title and location of project: Monitored retrievable storage facility, Clinch River Site, Tennessee

2. Project No.: 87-W-101

9. Purpose, Justification of Need for, and Scope of Project (continued)

2. Improvements in system-development schedules and activities. Section 302(a)(5) of the Act obligates DOE, in return for payments of fees by the utilities operators, to begin to accept the spent fuel for disposal by January 31, 1998. Doe fully intends to meet this objective. By starting operations in 1996 and reaching full capacity by 1998, the MRS facility would allow the system to receive spent fuel at full-scale rates 5 years sooner than does the currently authorized system. The development of the transportation system will also be expedited, because the MRS facility will allow the DOE to determine the routing, logistics, and equipment requirements for shipments from reactors up to 5 years earlier. Moreover, the facility would provide a focal point for early integration of and deployment of some functions of the system.

3. Improvements in the performance of the transportation system. By allowing consolidated fuel to be shipped in dedicated trains, the MRS facility will significantly reduce the number of shipments. Furthermore, the MRS facility would serve as a hub for transportation operations, thus significantly enhancing the control and management of transportation operations.

Studies performed in support of the proposal to Congress show that, though there are other ways to achieve some of the advantages of an integral MRS facility, none of the alternatives examined in the need and feasibility study presents the same range of benefits while also providing equivalent feasibility and managerial control.

If approved, the MRS facility will receive and prepare spent fuel for emplacement in the geologic repository. The proposed facility will be capable of receiving, consolidating, packaging and shipping 3,000 metric tons of (uranium equivalent) spent fuel per year while operating three shifts per day, five days per week. The principal waste-preparation functions would be spent-fuel consolidation and loading into sealed canisters. Being uniform in size, seal welded, and free of radioactive contamination, these canisters will facilitate safer handling, shipping, and further processing at the repository. Consolidation will be performed by removing the spent-fuel rods from the hardware that holds them together in assemblies and rearranging them in a tighter array for greater efficiency in storage, handling, and transportation.

The canisters of spent fuel will be loaded into shipping casks and shipped to the repository in dedicated trains. An area for temporarily storing the spent fuel pending shipment to the repository will be provided in the principal waste-handling building of the MRS facility; it would accommodate up to 1,000 metric tons of uranium (MTU) in storage vaults in the building. However, at the start of MRS operations, which will precede waste acceptance at the repository, and later during temporary slowdowns at the repository, this large storage will be insufficient. The scope of the MRS facility will therefore also include a large storage yard in which the canisters of spent fuel will be stored in sealed concrete casks that will allow radiation monitoring and easy retrieval for shipment to the repository. The DOE is recommending that such storage capacity (total possession limit) be limited to 15,000 MTU.

CONSTRUCTION PROJECT DATA SHEETS

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1. Title and location of project: Monitored retrievable storage facility, Clinch River Site, Tennessee
2. Project No.: 87-W-101

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9. Purpose, Justification of Need for, and Scope of Project: (continued)

The MRS facility will be designed, constructed, and operated such that the health and safety of the public and the quality of the environment will be protected. It will be licensed by the Nuclear Regulatory Commission. It will be a containment facility that will keep any releases of radioactive material well below regulatory limits, and its containment features are based on available and proved technology.

No significant adverse environmental impacts are expected from an integral MRS facility. The estimated total system risks and environmental costs do not differ significantly between systems with and without an MRS facility.

10. Details of Cost Estimate:

	Item Cost	Total Cost
a. Engineering, design and inspection		$102,800[a]
(1) Definitive Design	$ 64,900	
(2) Field Inspection	37,900	

This cost estimate is approximately 13,2% of the cost of construction.

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[a] Includes escalation at the rates given on the attached Table A.1, Appendix A. Estimate based on conceptual design that is 100% complete.

CONSTRUCTION PROJECT DATA SHEETS

1. Title and location of project: Monitored retrievable storage facility, Clinch River Site, Tennessee

2. Project No.: 87-W-101

10. Details of Cost Estimate: (continued)

Item	Item Cost			Total Cost
b. Land and land rights				$ 0[a]
Construction costs				779,300[b]
(1) Improvements to land (site work, on- and off-site)			$ 93,500	
(2) Buildings			537,300	
(a) R&H building ($688/SF for 709,025 SF)		$487,800		
1. Building	$242,800			
2. Hot cell & In-building SF storage[c] (3,321,650 CF)	91,200			
3. HVAC	78,200			
4. Piping	26,100			
5. Electrical	24,900			
6. Instrumentation/communication/alarms	24,600			
(b) Support facilities ($251/SF for 195,040 SF)[d]		49,500		
(3) Other structures			37,800	
(a) CHTRU storage facility		2,000		
(b) SF and HAW/RHTRU storage facilities[e]		35,800		
(4) Special facilities			102,800	
(a) Hot cell equipment		90,500		
(b) Transporter & lifting equipment		12,300		
(5) Utilities (includes water, fuel oil, electrical power & sewers)			7,800	
c. Standard equipment				17,000[b]
(1) Furnishings and laboratory equipment			5,400	
(2) Shop equipment			3,200	
(3) Site vehicles and utility equipment			8,400	

[a] Cost to be incurred for land acquisition or use of site has not been determined.

[b] Includes escalation at the rates given on the attached Table A.1, Appendix A.

[c] Includes cost of 1,000 MTU of spent fuel canister storage area within the building.

[d] Support facilities include the following: Admin. bldg., Site services bldg., Security bldg., three Gate/Badgehouse, Vehicle Maint. bldg., Warehouse bldg., Water treatment facility, Sewage treatment facility, Steam generator bldg. Fire station, and Standby generator bldg.

[e] Spent fuel and HAW/RHTRU storage facilities include costs of fencing, intrusion detection and site work for 15,000 MTU of cask storage, and installation of concrete pads for 5,000 MTU of cask storage.

CONSTRUCTION PROJECT DATA SHEETS

1. Title and location of project: Monitored retrievable storage facility, Clinch River Site, Tennessee
2. Project No.: 87-W-101

10. Details of Cost Estimate: (continued)

Item	Item Cost	Total Cost
e. Major computer items		12,100$^{(a)}$
(1) Distribution control system	3,100	
(2) Programmable logic controller system for hot cell	9,000	
Subtotal		911,200$^{(a)}$
f. Contingency (approx. 17% of all items a through e)		193,000
Total Estimated Costs		\$1,104,200$^{(a)}$

(a) Includes escalation at the rates given on the attached Table A.1, Appendix A.

11. Method of Performance:

The project has been designated as a Major Systems Acquisition (MSA) for which the management provisions of DOE Order 5700.4A would apply. Procurement(s) will be made for work in design, construction management, operations, and technical support. A divison of work among a contractor(s) (a procurement strategy) has not been finalized. Construction and procurement would be accomplished by fixed-price or cost-plus-fixed-fee contract awards on the basis of competitive bidding and negotiations.

The construction and operation of the MRS facility would be under the purview of a DOE Project Office established in the DOE Oak Ridge Operations Office. The day-to-day management of the facility would be the responsibility of a DOE MRS project manager during the preoperational phase and an MRS plant manager during operations.

1. Title and location of project: Monitored retrievable storage facility, Clinch River site, Tennessee

2. Project No.: 87-W-101

12. Funding Schedule of Project Funding and Other Related Funding Requirements ($K) (footnote 1)

	Prior Yrs. Cost and Budgeted Cost Thru 6/86 (footnote 2)	FY86 7/86 thru 9/86 (footnote 3)	FY87	FY88	FY89	FY90	FY91	FY92	FY93	FY94	FY95	FY96	TOTAL
4. Total Project Costs	$	$	$	$	$	$	$	$	$	$	$	$	$
1. Total Facility Costs	0	0	2,200	19,900	30,900	26,200	52,100	208,400	271,200	288,300	194,100	10,900	1,104,200
(a) Construction line item (4)	0	0	0	0	0	0	0	0	0	0	0	0	0
(b) PE&D	0	0	0	0	0	0	0	0	0	0	0	0	0
(c) Operating exp. funded equip.	0	0	0	0	0	0	0	0	0	0	0	0	0
(d) Inventories	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Facility Cost	$ 0	$ 0	$ 2,200	$ 19,900	$ 30,900	$ 26,200	$ 52,100	$ 208,400	$ 271,200	$ 288,300	$ 194,100	$ 10,900	$ 1,104,200
2. Other Project Costs	$	$	$	$	$	$	$	$	$	$	$	$	$
(a) Conceptual design	15,400	0	0	0	0	0	0	0	0	0	0	0	15,400
(b) Design verification (4,5)	0	0	1,900	3,200	500	3,900	7,000	5,900	200	0	200	0	22,800
(c) Site data verification (4)	0	200	3,900	1,800	1,200	0	0	0	0	0	0	0	7,100
(d) Operational support (4)	0	0	1,400	3,500	3,700	2,900	2,100	3,400	3,200	3,300	2,100	900	26,500
(e) Training and startup (4,6)	0	0	0	0	500	900	2,000	3,900	8,300	20,300	27,400	45,500	108,800
Total Other Projects	$ 15,400	$ 200	$ 7,200	$ 8,500	$ 5,900	$ 7,700	$ 11,100	$ 13,200	$ 11,700	$ 23,600	$ 29,700	$ 46,400	$ 180,600
Total Project Cost	$ 15,400	$ 200	$ 9,400	$ 28,400	$ 36,800	$ 33,900	$ 63,200	$ 221,600	$ 282,900	$ 311,900	$ 223,800	$ 57,300	$ 1,284,800

(1) See table E.8, Spending and Funding Schedule (millions of constant 1985 dollars) in Appendix E, Monitored Retrievable Storage Submission to Congress volume 3, Program Plan, Jan. 1986, DOE/RW-0035. Costs given in Table E.8 have been escalated for the given years per Appendix A of these data sheets.

(2) Actual costs through September 1985 plus authorized funds through June 1986.

(3) Funding requirements July 1986 through September 1986.

(4) Escalation is calculated per the previous reference.

(5) The cost of the established rod consolidation program, PCDP, have not been included. Transfer of such costs to the MRS may be desirable.

(6) Spare parts cannot be identified at this stage of design and are not separately estimated.

CONSTRUCTION PROJECT DATA SHEETS

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1. Title and location of project: Monitored retrievable storage facility,
Clinch River site, Tennessee

2. Project No.: 87-W-101

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12. Funding Schedule of Project Funding and Other Related Funding Requirements (BO) (footnote 1) (continued)

	Prior Yrs. Cost and Budgeted Cost Thru 6/86 (footnote 2)	FY86 7/86 thru 9/86 (footnote 3)	FY87	FY88	FY89	FY90	FY91	FY92	FY93	FY94	FY95	FY96
3. Total Related Funding (1)	$	$	$	$	$	$	$	$	$	$	$	$
(a) Facility operating cost (4)	0	0	0	0	0	0	0	0	0	0	0	16,100
(b) Programmatic cap. equip. (5)	0	0	0	0	0	0	0	0	0	9,000	11,500	46,100
(c) Maintenance, repair, GPP, or other construction related to programmatic effort in the facility (6)	0	0	0	0	0	0	0	0	0	0	0	0
(d) Other programmatic support costs (7)	14,600	2,600	12,100	11,300	10,800	8,900	7,900	7,400	7,000	7,300	5,600	2,600
Total Related Costs	$ 14,600	$ 2,600	$ 12,100	$ 11,300	$ 10,800	$ 8,900	$ 7,900	$ 7,400	$ 7,000	$ 16,300	$ 17,100	$ 64,800
Total Related Costs Including Escalation (8)	$	$	$ 13,400	$ 13,200	$ 13,400	$ 11,700	$ 10,500	$ 11,000	$ 11,000	$ 27,300	$ 29,900	$ 122,200

(1) All costs not escalated are expressed in 1985 dollars.
(2) Actual costs through September 1985 plus authorized funds through June 1986.
(3) Funding requirements July 1986 through September 1986.
(4) There is a similar ramp down of operating costs during the loadout period of FY 2018 through FY 2021 as indicated for facility startup.
(5) Includes the cost to fabricate the sealed storage casks as required.
(6) Includes cost of capital improvements and modifications to the facility and construction of more concrete support pads for casks.
(7) Includes program management, regulatory compliance, and environmental evaluations costs.
Institutional costs for financial assistance/tax equivalency/impact statements are not included. Such costs are subject to negotiation under a consultation and cooperative agreement.
When such costs are specifically determined, they will be provided in updated data sheets.
(8) Escalation is calculated per the previous reference.

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1. Title and location of project: Monitored retrievable storage facility, Clinch River Site, Tennessee

2. Project No.: 87-W-101

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12. Funding Schedule of Project Funding and Other Related Funding Requirements: (BO)[a] (continued)

b. Other related annual costs (Estimated operating life of facility: 26 years)

1. Facility operating costs...	$ 59,000
2. Programmatic capital equipment[b]..	37,125
3. Maintenance, repair, GPP, or other construction related to programmatic effort in the facility[c]..	10,600
4. Other programmatic support costs[d]......................................	536
Total Related Costs..	$107,261

[a] All costs not escalated are expressed in 1985 dollars.

[b] Includes the cost to fabricate the sealed storage casks as required (12,000 - 13,000 MTU - Total)

[c] Includes cost of capital improvements and modifications to the facility and construction of more concrete support pads for cases (12,800 - 13,800 MTU).

[d] Includes program management, regulatory compliance, and environmental evaluations costs.

Note: 1) Decommissioning costs start in 2022 and continue through 2028.
2) Transportation costs and tax equalivancy payments are not included.

CONSTRUCTION PROJECT DATA SHEETS

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1. Title and location of project: Monitored retrievable storage facility, Clinch River Site, Tennessee

2. Project No.: 87-W-101

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13. Narrative Explanation of Total Project Funding and Other Related Funding Requirements:

A. Total Project Funding

1. Total Facility Cost
   - (a) Construction line item -- no narrative required.
   - (b-d) There are no plant engineering and design costs, no operating expense funded equipment cost, and no inventory cost associated with this facility. -- no narrative required.
2. Other Project Costs
   - (a) Conceptual design costs - the conceptual design was prepared by Ralph M. Parsons Co. beginning December 1983 and continuing through July 1986. Actual costs are totaled through September 1985 with the budget amount added through June 1986. Major deliverables were received in September 1985 with the subsequent contract time used for consulting and records close-out -- $15,400,000.
   - (b) Design verification cost - the conceptual design uses mature technologies for the spent fuel handling and processing subsystems. However, these "subsystems" have not been demonstrated as a combined system under the operating conditions and production rates required for the MRS facility. The design verification cost is the projected amount to perform these demonstrations -- $22,800,000.
   - (c) Site verification cost - the site data required for engineering design need to be confirmed and gathered for this activity -- $6,900,000.
   - (d) Operational Support - overview and liaison of design construction management contractor(s) $26,700,000.
   - (e) Training and startup cost - Training and startup testing costs for the facility -- $108,800,000.
   - (f) Decommissioning cost - decommissioning of the facility is planned for 2022 through 2026. Costs given are expressed in 1985 dollars -- $79,000,000.

B. Total Related Funding Requirements - per the current DOE Mission plan, the facility will have an operating life of 26 years (1996 through 2022). The design life of the facility is 50 years.

1. Facility operating costs - the major elements of the annual operating costs are a) the operations and maintenance staff for receiving, handling, processing and storing spent fuel and for upkeep of the building heating, ventilating, and air conditioning (HVAC) systems and equipment; b) spent fuel processing consumables including canisters, drums and high-efficiency particulate air (HEPA) filters; and c) utilities including electricity and fuel oil/diesel. The facility has a "ramp up and ramp down" cycle at each end of the normal operating period. The annual cost for the normal operating period is estimated to be $61,600,000 expressed in FY 1985 dollars.

CONSTRUCTION PROJECT DATA SHEETS

1. Title and location of project: Monitored retrievable storage facility, Clinch River Site, Tennessee 2. Project No.: 87-W-101

13. Narrative Explanation of Total Project Funding and Other Related Funding Requirements (continued)

2. Programmatic capital equipment costs - to provide for the interim storage capability at the facility sealed storage casks (concrete casks) are required for storing the canisters of spent fuel. It is anticipated that a fabrication plant would be constructed near the MRS facility to supply these casks. The cost of the facility is included in the cost of the casks. The annual cost for the normal fabrication rate is estimated to be $52,700,000 expressed in 1985 dollars.
3. Maintenance, repair, GPP, or other construction related to programmatic effort in the facility - it is anticipated that General Plant Projects (GPP) or other major modifications to the facility and/or processing areas will require an estimated $10,300,000 per year expressed in 1985 dollars. In addition, twice in the early years of the facility (1998 and 2000) more concrete pads will be required for the emplacement of the sealed storage casks. These are estimated to cost $12,000,000 each (in both 1998 and 2000) expressed in 1985 dollars.
4. Other programmatic support costs - The overall program management from start of design-construction management procurement through decommissioning is estimated to cost $100,700,000 expressed in 1985 dollars. Included in this item is the program management cost, regulatory compliance cost, and environmental evaluations cost. Not included in this item are costs for institutional relations, such as revenues equivalent to taxes, consultation and cooperation costs, aid for mitigating impacts of construction and operation, transportation costs, and licensing and permitting costs associated with other federal, state and local entities. The majority of these costs are expended prior to the operation of the facility. As these costs become available, they will be provided in the annually required updated construction project data sheets. Program management during the normal operating period of the facility (1998 through 2017) is estimated to be $400,000 per year.

Appendix A

Inflation Index (1985 = 100)

Table A. 1
Construction

Year	Index*	% Annual Change
1985	100.0	0.0
1986	104.9	4.9
1987	110.5	5.3
1988	116.8	5.7
1989	123.7	5.9
1990	131.1	6.0
1991	139.4	6.3
1992	148.1	6.3
1993	157.5	6.3
1994	167.4	6.3
1995	177.9	6.3
1996	188.6	6.0

Table A.2
Operating

Year	Index*	% Annual Change
1985	100.0	0.0
1986	103.7	3.7
1987	107.8	4.0
1988	112.4	4.2
1989	116.9	4.0
1990	121.2	3.7
1991	125.3	3.4
1992	129.3	3.1

*Each index number was rounded to one significant digit before applying the percentage annual change. The index numbers are compounded for each subsequent year.

Sources: Energy Information Administration
Annual Energy Outlook
1984 With Projections To 1995
DOE/EIA-0383(84), Table A 19, p. 222
6% annual change rate assumed after 1995

Office of Management and Budget
3.1% annual change rate assumed after 1991